	Presenter:
	Organization/Date: Orbiter/11-15-01

BACKUP INFORMATION

	Presenter:
	Organization/Date: Orbiter/11-15-01

PREVIOUS FLIGHT ANOMALIES BACKUP

	Presenter:
	Organization/Date: Orbiter/11-15-01

STS-105
IN-FLIGHT ANOMALIES
BACKUP

STS-105-V-01: LEFT OMS OXIDIZER CROSSFEED LOW POINT DRAIN LINE HEATER FAILURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Observation:

- Left OMS crossfeed oxidizer low point drain line B heater stopped cycling

Concern:

- Loss of redundancy in heater system

Discussion:

- Low point drain line B heater had been cycling on/off at 63°F and 87°F per temp sensor (V43T6236A) control points
- After ~ 4 days of B heater operation, the heater failed to turn on at the 63°F set point
- Crew switched heaters from B to A when the line temperature reached 41°F
  - Heater cycling returned to normal ranges for A heaters (53°F to 71°F)

STS-105-V-01: LEFT OMS OXIDIZER CROSSFEED LOW POINT DRAIN LINE HEATER FAILURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Actions In Work:

- KSC troubleshooting confirmed that the thermostat is failed open
  - Thermostat will be R&R'd

Risk Assessment:

- Failed open thermostat/failed off heater is Crit 2R/3
  - Redundant heater system exists
    - Manual switch throw required
    - Sufficient reaction time exists
- Loss of redundant heater system
  - Orbiter attitude workarounds would be necessary for thermal control
    - Potential ISS mission impact

STS-105-V-01: LEFT OMS OXIDIZER CROSSFEED LOW POINT DRAIN LINE HEATER FAILURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Acceptable for STS-108 Flight:

- No indication of crossfeed heater/thermostat problems on OV-105
- Redundant heaters and thermostats exist
- Not a safety of flight issue

STS-105-V-02: LOSS OF AC2 PHASE 'A' DURING MPM STOW

Presenter:

Organization/Date:
Orbiter/11-15-01

Observation:

- During pre-deorbit stow of the RMS Manipulator Positioning Mechanisms (MPMs), the mechanism drove at dual motor time, but motor 2 was missing AC2 phase A

Concern:

- Failure reduces AC2 Mid Motor Controller Assembly 2 (MMC2) bus phase power redundancy to affected motors

Discussion:

- At payload bay door opening and when MPMs were first deployed, all three phases were present on MMC2 AC2
  - However, only 2 of 3 phases were present when the RMS MPMs were stowed

STS-105-V-02: LOSS OF AC2 PHASE 'A' DURING MPM STOW	Presenter:
	Organization/Date: Orbiter/11-15-01

Discussion (Cont):

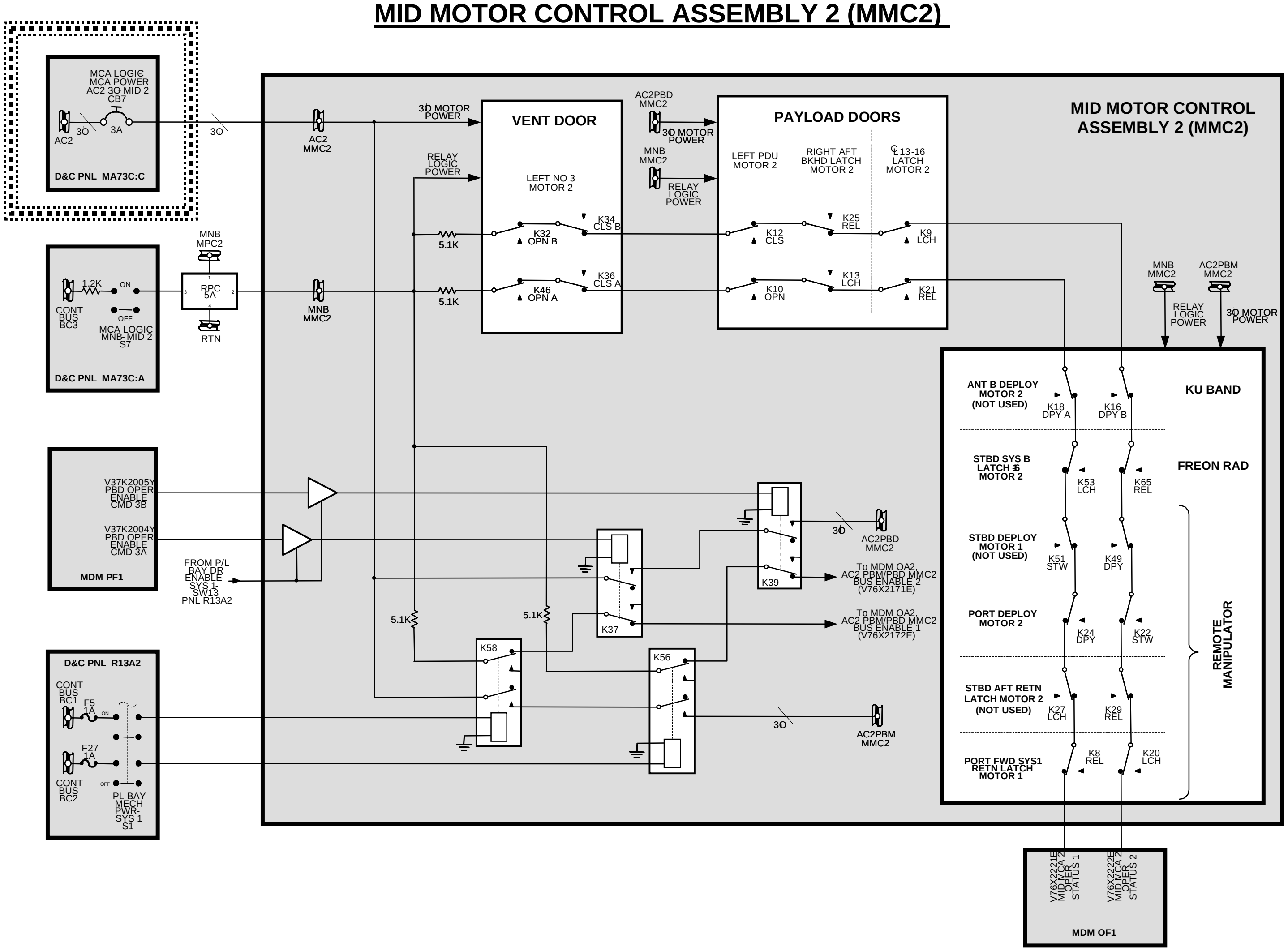
- The AC2 MMC bus provides power to various components, all of which were found to have phase A current missing after this point in time
  - Port payload bay door drive motor 2
  - Starboard payload bay door aft bulkhead latch motor 2
  - Payload bay door centerline latch 13-16 motor 2
  - Left vent door 3 motor 2
- All motors powered by the MMC2 AC2 are designed to operate on two phases
- A three phase ganged AC circuit breaker CB7 on panel MA73C provides protection to MMC2 AC2 power circuits
- Based on observed anomalies and circuit analysis, the most probable cause of this failure was believed to be a contaminated contact in the circuit breaker

STS-105-V-02: LOSS OF AC2 PHASE 'A' DURING MPM STOW

Presenter:

Organization/Date:
Orbiter/11-15-01

MID MOTOR CONTROL ASSEMBLY 2 (MMC2)



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USA United Space Alliance

STS-105-V-02: LOSS OF AC2 PHASE 'A' DURING MPM STOW	Presenter:
	Organization/Date: Orbiter/11-15-01

Actions Taken:

- Post-landing KSC troubleshooting isolated the problem to the MMC2 AC2 power circuit breaker CB7 on D&C panel MA73C
  - Oxidation on the contacts has historically been the root cause of circuit breaker problems
  - The OMRSD provides for cycling the CB at least 5 times in an attempt to clean the contacts and clear the problem
  - Circuit breaker was cycled and phase 'A' was recovered with the second cycling of the breaker
- Decision made to remove and replace CB7 and perform failure analysis
  - Plan is to evaluate circuit breaker condition and evaluate and compare its condition to other recent circuit breaker failures
- D&C Panel MA73C is scheduled to be shipped to NSLD during OMM processing flow power down period

STS-105-V-02: LOSS OF AC2 PHASE 'A' DURING MPM STOW	Presenter:
	Organization/Date: Orbiter/11-15-01

Risk Assessment:

- Motor Control Assembly (MCA) AC motors are driven by 3 phase power sources; a failure of one phase will not result in the loss of the capability to drive that motor
- All of these actuators have redundant motors
  - Capable of performing the intended function with one of two motors, given the remaining motor is powered by all 3 AC phases
  - Redundant motor receives power through a separate circuit breaker/bus
- OMRSD and Flight Rules recovery procedures are available to to recover circuit breaker function if required

STS-105-V-02: LOSS OF AC2 PHASE 'A' DURING MPM STOW	Presenter:
	Organization/Date: Orbiter/11-15-01

Acceptable for STS-108 Flight:

- Circuit breaker function is verified during system ground testing and operations
- Vehicle systems redundancy and workarounds exist to accommodate circuit breaker failures
  - In the event of a similar failure, all MCA AC motors will function with only 2 of 3 phases energized
  - Actuators are designed with redundant motors and are capable of performing the intended function with one of two motors
    - Redundant motor receives power through a separate circuit breaker/bus
  - OMRSD and Flight Rule recovery procedures are available to recover circuit breaker function if required

	Presenter:
	Organization/Date: Orbiter/11-15-01

STS-100
IN-FLIGHT ANOMALIES
BACKUP

STS-100-V-01: FES H_2O FEEDLINE B ZONE 3 HEATER STRING 1 FAILURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Observation:

- FES B (stbd) supply H_2O feedline heater 1 zone 3 failed off

Concern:

- Without corrective action, loss of a second heater may result in FES feedline freezing and potential loss of one of the FES systems

Discussion:

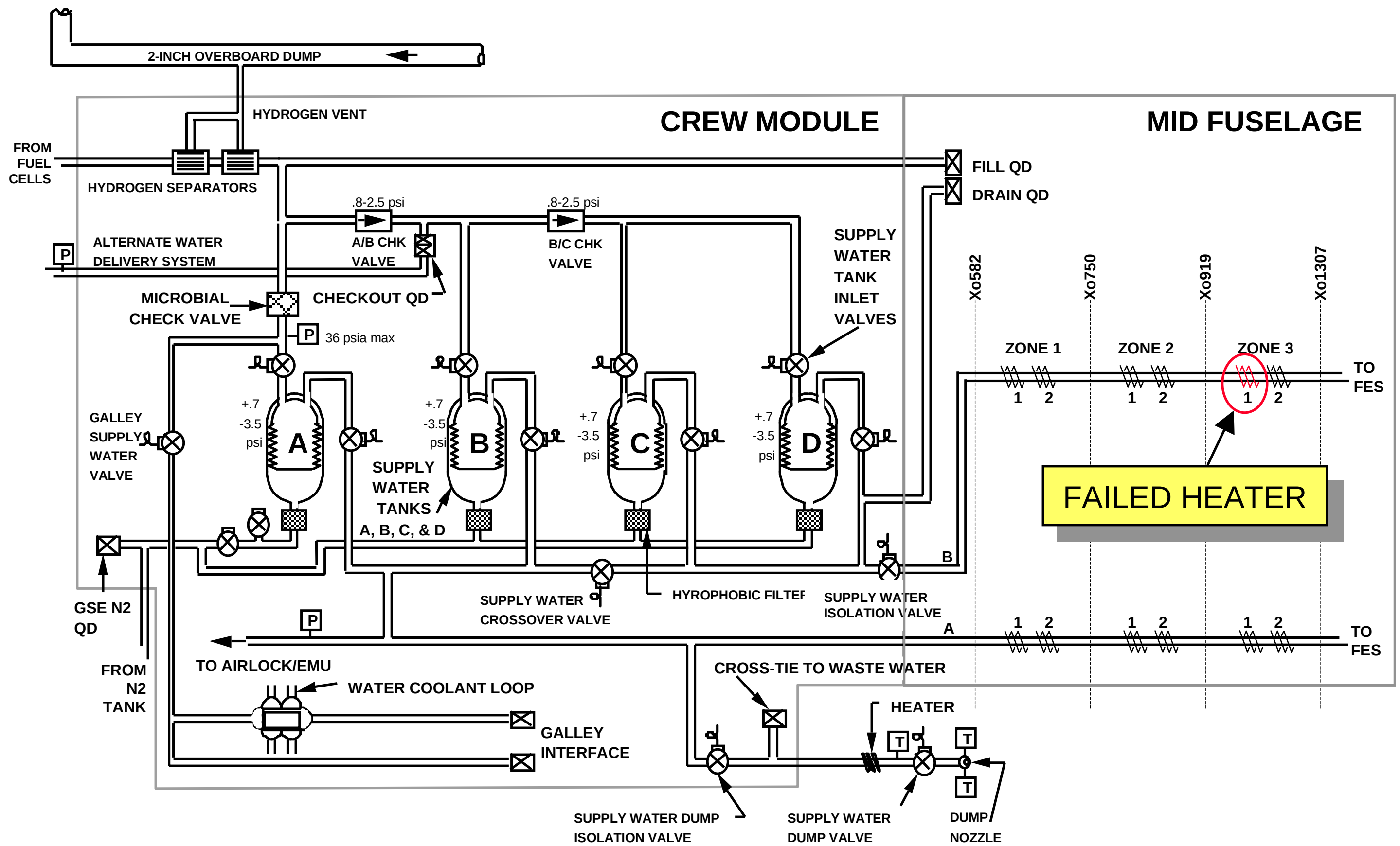
- Water line temperature (V63T1875A) in zone 3 drifted to around 52°F at MET 000:13:00 (vs 65°F to 90°F typical) indicating heater failure
  - No heater cycles seen following application of heater string 1 power post-launch
- Heater is required to prevent water line freezing
  - There are two heater strings per feedline
- Heater string 2 was enabled at MET 000:17:20 and system performed nominally
- A contingency line purging procedure was in place in the event of a second heater string failure

STS-100-V-01: FES H_2O FEEDLINE B ZONE 3 HEATER STRING 1 FAILURE

Presenter:

Organization/Date:
Orbiter/11-15-01

SUPPLY WATER SYSTEM



STS-100-V-01: FES H_2O FEEDLINE B ZONE 3 HEATER STRING 1 FAILURE

Presenter:
Organization/Date: Orbiter/11-15-01

Actions Taken:

- Post-flight troubleshooting found a broken wire at the heater ground point
- Ground wire was repaired and the heater string successfully retested

Acceptable for STS-108 Flight:

- Heater failure isolated to a broken heater ground point wire which was repaired and successfully retested
- In the event of a heater failure, the redundant heater string is available
- With loss of both heater strings, a contingency procedure to purge the affected line is in place to prevent freezing and allow recovery of the system for entry

STS-100-V-03: WSB 3 ANOMALOUS TEMPERATURE RESPONSE ON CONTROLLER B	Presenter:
	Organization/Date: Orbiter/11-15-01

Observation:

- WSB #3 temperatures for GN_2 tank, water tank and WSB core rose abnormally on controller B

Concern:

- Failure might result in loss of WSB cooling and therefore loss of one APU

Discussion:

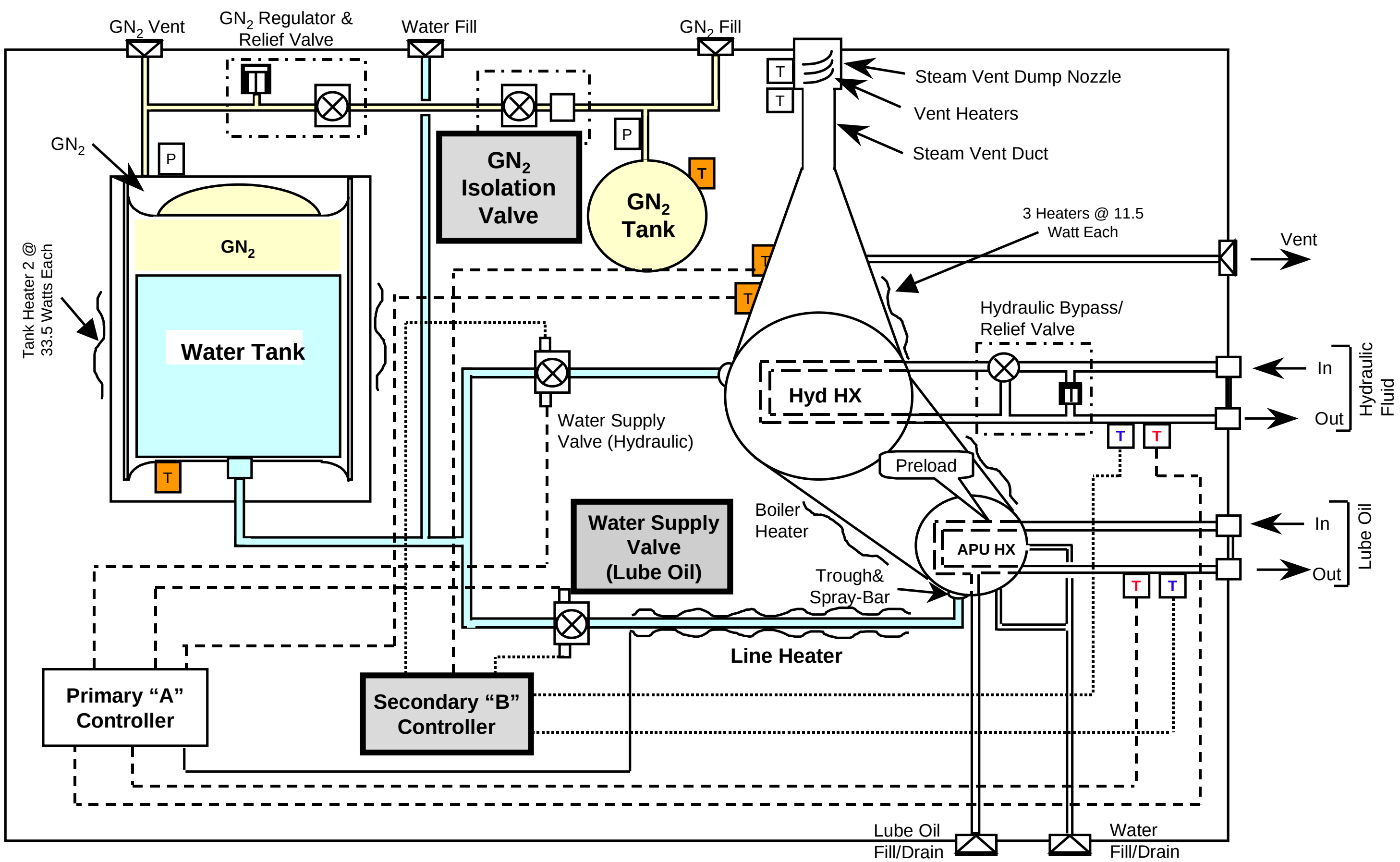
- WSB 3 was switched, as planned, from controller A to controller B approximately 24 hours after launch
  - Three WSB 3 temperature measurements rose unexpectedly over the next three days
    - GN_2 tank temp increased from 78°F to 83°F
    - Core temp increased from 72°F to 77°F
    - Water tank temp increased from 75°F to 78°F
- WSB 3 was switched back to A controller after 77 hrs on the B controller
  - Temperatures recovered to normal
  - As a result, the feedline heater remained on for the rest of the mission

STS-100-V-03: WSB 3 ANOMALOUS TEMPERATURE RESPONSE ON CONTROLLER B

Presenter:

Organization/Date:
Orbiter/11-15-01

WATER SPRAY BOILER SYSTEM SCHEMATIC



STS-100-V-03: WSB 3 ANOMALOUS TEMPERATURE RESPONSE ON CONTROLLER B	Presenter:
	Organization/Date: Orbiter/11-15-01

Actions Taken:

- Post-flight troubleshooting isolated the source of the heat to the GN_2 isolation valve
  - A failure within the “B” controller (S/N 37) caused the isolation valve to remain powered and act as a heater, supplying 37.5 watts of electrical energy
    - GN_2 iso valve temperature increased from 73°F to 156°F in ~ 2 hours in atmospheric environment
    - Multiple single point failures within individual controllers can produce this failure
- Flight failure scenario simulated utilizing a spare GN_2 iso valve in a thermal / vacuum test
  - Valve outlet port temp increased from 70°F to 225°F in ~ 2 hrs
  - Analytically it was determined that this would correlate to a coil “B” temp of ~ 330°F

STS-100-V-03: WSB 3 ANOMALOUS TEMPERATURE RESPONSE ON CONTROLLER B	Presenter:
	Organization/Date: Orbiter/11-15-01

Actions Taken: (Cont)

- The S/N 37 controller was removed and routed to NSLD for TT&E
  - The failure was isolated to circuit board # 8 (S/N 50) as the cause for the continuous power output to the GN_2 iso valve
  - Circuit board S/N 50 was removed/replaced with S/N 93
- Controller S/N 37 subsequently passed ATP and was reinstalled on OV-105 as the WSB 3B controller
  - Controller passed on-vehicle OMRSD checkout
- Testing / failure analysis of the failed circuit board revealed that capacitor C807 had experienced a high current leakage failure
  - The failed capacitor was removed and sent to NSLD for destructive analysis to determine the cause of failure

STS-100-V-03: WSB 3 ANOMALOUS TEMPERATURE RESPONSE ON CONTROLLER B	Presenter:
	Organization/Date: Orbiter/11-15-01

Actions Taken: (Cont)

- As a precautionary measure, the OV-105 WSB system 3 GN2 iso valve and the lube oil water valve were R&R'd due to extended high temperature exposure (~72 hrs) during the mission
  - Exposure exceeded 24 hour certification limit
  - Upon successful completion of ATP, both valves will be returned to logistics as spares
- OMRSD checkout was successfully accomplished on OV-105 for these replaced components

STS-100-V-03: WSB 3 ANOMALOUS TEMPERATURE RESPONSE ON CONTROLLER B	Presenter:
	Organization/Date: Orbiter/11-15-01

Risk Assessment:

- Alternate controller is available
- Analysis shows with continued operation on a controller producing this temperature anomaly, there are no adverse effects on WSB system
  - No issue with GN_2 tank, water tank, or WSB container over-pressurization
  - GN_2 iso valve & lube oil water valve operation were not compromised as evidenced by nominal operation during STS-100 entry

Acceptable for STS-108 Flight:

- Components causing the anomaly, as well as potentially affected components were R&R'd
  - Replacement components were verified per OMRSD test requirements
- In the event of a similar failure, the WSB will be switched to the alternate controller

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Observation:

- RCS vernier thruster S/N 401(R5D) had low combustion chamber pressure (Pc) indications on several pulses in preparation for undocking with ISS

Concern:

- Potential for deselection of R5D vernier thruster

Discussion:

- Vernier thruster R5D Pc was intermittently low prior to undock through final use prior to entry
  - Pc varied from low of 50 psia to nominal ~108 psia
- Injector temperatures were nominal during this time
- RM did not deselect R5D - Pc never fell below the 26 psia limit
- Prior to occurrence, R5D had been used for two reboost sessions with nominal Pc

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Discussion (Cont):

- Possible causes of low Pc:
  - Flow restriction in oxidizer or fuel valve
  - Combustion products (FORP) in Pc tube
  - Hot propellant

Summary of Actions Taken:

- Pre-removal visual and borescope inspections
- Failure analysis of R5D at WSTF
- Historical data review / analysis

Visual and Borescope Inspections:

- Visual Inspection
  - Found yellow/orange area in divergent area of nozzle however, this discoloration pattern is not uncommon and has been observed on other VRCS thrusters
  - No external abnormalities on Pc tube
- Borescope inspection of combustion chamber showed no sign of contamination on injector and no evidence of blockage at Pc port

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Results of WSTF F/A:

- Pc transducer and Pc tube - no anomalies found
- Both thruster valves passed leak test
- Oxidizer valve - no contamination/anomalies found
- Fuel valve
  - No contamination in fuel flow path
  - Valve failed force/deflection test - short stroke & high pre-load
  - Valve seal was slightly extruded into flow path
    - Force/deflection test corroborated seal extrusion condition
  - Flow test resulted in a 5-6% reduction in flow rate compared to previous ATP data - also corroborated seal extrusion condition
  - Dynamic flow test - pulsing flow rate tests were inconclusive due to slow flow meter response

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Flight Data Evaluation Results:

- Flight / historical data reviewed for STS-100, STS-97, STS-99, STS-102, STS-47, STS-40 & STS-29
- R5D (S/N 401) experienced numerous low-Pc's during STS-100 and several, but much fewer, during last flight (STS-97)
  - "Check mark" Pc signature on some low-Pc pulses, both flights
    - Low Pc is not an unusual characteristic of vernier thrusters and has been seen before, but is generally of a much shorter duration and occurring less often
      - Previously attributed to temporary valve nitrate blockage and hot propellant
    - R5D behavior was noticeably more chronic, particularly at the end of the mission
  - No unexplained low Pc's observed on R5D (S/N 401) during STS-99 (flight prior to STS-97)

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Flight Data Evaluation Results (Cont):

- R5D & L5D Pc vs oxidizer inlet temperature, STS-100
  - R5D showed a significant trend toward reduced Pc with increasing ox inlet temperature
    - Oxidizer inlet temperatures ranged from 105 to 129°F during low-Pc occurrences
    - Downtrend more apparent later in the mission
  - R5D Pc also trended downward slightly when fired with nominal (~70°F) oxidizer inlet temps as mission progressed
  - L5D showed a slight decrease in Pc with increasing ox inlet temperature - trend was constant throughout mission
    - L5D oxidizer inlet temperatures averaged slightly higher than R5D throughout STS-100

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

OEM and WSTF Data Evaluation Results:

- Effects of hot propellant on VRCS thruster operation
  - WSTF and Marquardt test data shows that Pc, mixture ratio (MR) and specific impulse decrease as prop temperature increases
  - Pc traces become erratic at higher propellant temperatures
    - “Check mark” signature occurred sometimes, on longer pulses (1-5 secs) similar to those observed on STS-100
    - With hot propellant present, Pc was initially low but tended to approach nominal on longer firings
  - No valve or thrust chamber problems or degradation were noted from WSTF and Marquardt hot propellant tests
- Worst case effect of low Pc on VRCS thrusters
  - Due to low MR, reduced oxidizer flow - efficiency decreases but thrust chamber wall temperatures are much higher than at nominal MR
    - Not a flight concern - Marquardt low MR tests showed no thrust chamber or valve degradation after numerous pulses and seconds of burn time

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

OEM and WSTF Data Evaluation Results (Cont):

- Cause/effect of fuel valve extrusion
  - Based on previous work, Teflon extrusion is most likely caused by high temperature cycling over time
  - The 5-6% steady-state fuel flow rate reduction determined at WSTF would not account for the R5D low-Pc by itself
  - WSTF inspected six scrapped fuel valve seals and found no evidence of extrusion
    - One of the six seals had more pulses, burn time and thermal cycles than S/N 401
    - All vernier thrusters installed on OV-105 for STS-108 have significantly fewer thermal cycles than S/N 401

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Conclusions:

- The R5D low-Pc occurrences were caused mainly by hot propellant based on flight and test data
  - Not a concern for valve or thrust chamber degradation
  - Did not adversely effect overall thruster functionality
- R5D's Pc appeared to be more sensitive to hot propellant than L5D, even though oxidizer inlet temperatures averaged higher on L5D
  - It is possible that the extruded fuel valve seal contributed more variability in Pc response
    - Both at higher inlet temperatures and, to a lesser degree, at nominal inlet temperatures
- Effect of low-Pc on thrust chamber
  - Presence of low-Pc will not affect the integrity of a VRCS thrust chamber

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Risk Assessment:

- Failed off vernier thruster due to blocked inlet valves / Pc transducer tube (crit 2/2)
  - Loss of single vernier thruster
    - Thruster would be deselected by RM
      - VRCS attitude control would be compromised or lost depending on which thruster is deselected
      - Potential effect on vernier reboost mission objective, depending on which thruster failed
      - Flight rules allow primary thruster use for docking, attitude control and reboost if necessary
  - Another potential effect of restricted fuel or oxidizer flow is an off-nominal mixture ratio
    - OEM data from off-nominal mixture ratio tests showed no deterioration of vernier thrust chamber
    - The worst-case effect is RM deselection of the thruster

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Acceptable for STS-108 Flight:

- R5D low-Pc was due primarily to hot propellant
  - R5D's Pc appeared to have a higher degree of sensitivity to hot propellant
  - It is possible that the extruded fuel valve seal contributed more variability in Pc response
  - Despite the hot propellant and extrusion, the overall functionality of R5D was not compromised
- No indication of low Pc on OV-105 vernier thrusters other than R5D (S/N 401) during last flight (STS-100)
  - S/N 401 was removed and replaced
- Not a safety of flight issue
  - Test data showed that low-Pc not detrimental to thrust chamber

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

Follow-on Actions:

- Hot fire test of S/N 401 to identify failure mode(s)
  - Compare performance with previous hot-fire ATP by hot-firing thruster at nominal conditions
  - Attempt to recreate failure mode by hot-firing thruster with various elevated propellant inlet temperatures
  - Determine effect of seal extrusion on thruster performance
  - Estimated test completion date is February 2002
- Perform further evaluation of extruded seal

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE

Presenter:

Organization/Date:
Orbiter/11-15-01

Data on scrapped VRCS thruster fuel valves inspected at WSTF

Fu Valve S/N	Thruster S/N	TMC Ship Date	KSC Remove Date	First Flight	Last Flight	Fuel Valve Total Pulses	Fuel Valve Total Burn time	Fuel Valve Total T. Cycles
111	109	Dec-78	Jun-99	STS-1	STS-86	51,861	52,108	712
205	452	Aug-87	Sep-99	STS-26	STS-93	47,228	39,316	646
208	204	Jul-81	Dec-98	STS-5	STS-95	49,833	43,963	622
215	302	Sep-82	Jun-99	STS-6	STS-86	93,303	132,065	2,397
218	305	Aug-82	Dec-97	STS-49	STS-86	37,693	43,144	672
219	403	Dec-82	Nov-97	STS-41D	STS-86	38,428	51,468	879
					Avgs.	53,058	60,344	988
	401			STS-26	STS-100	73,196	100,479	1,678

Pulses, burn time and thermal cycles on OV-105 VRCS thrusters

(Data since most recent fuel valve R&R)

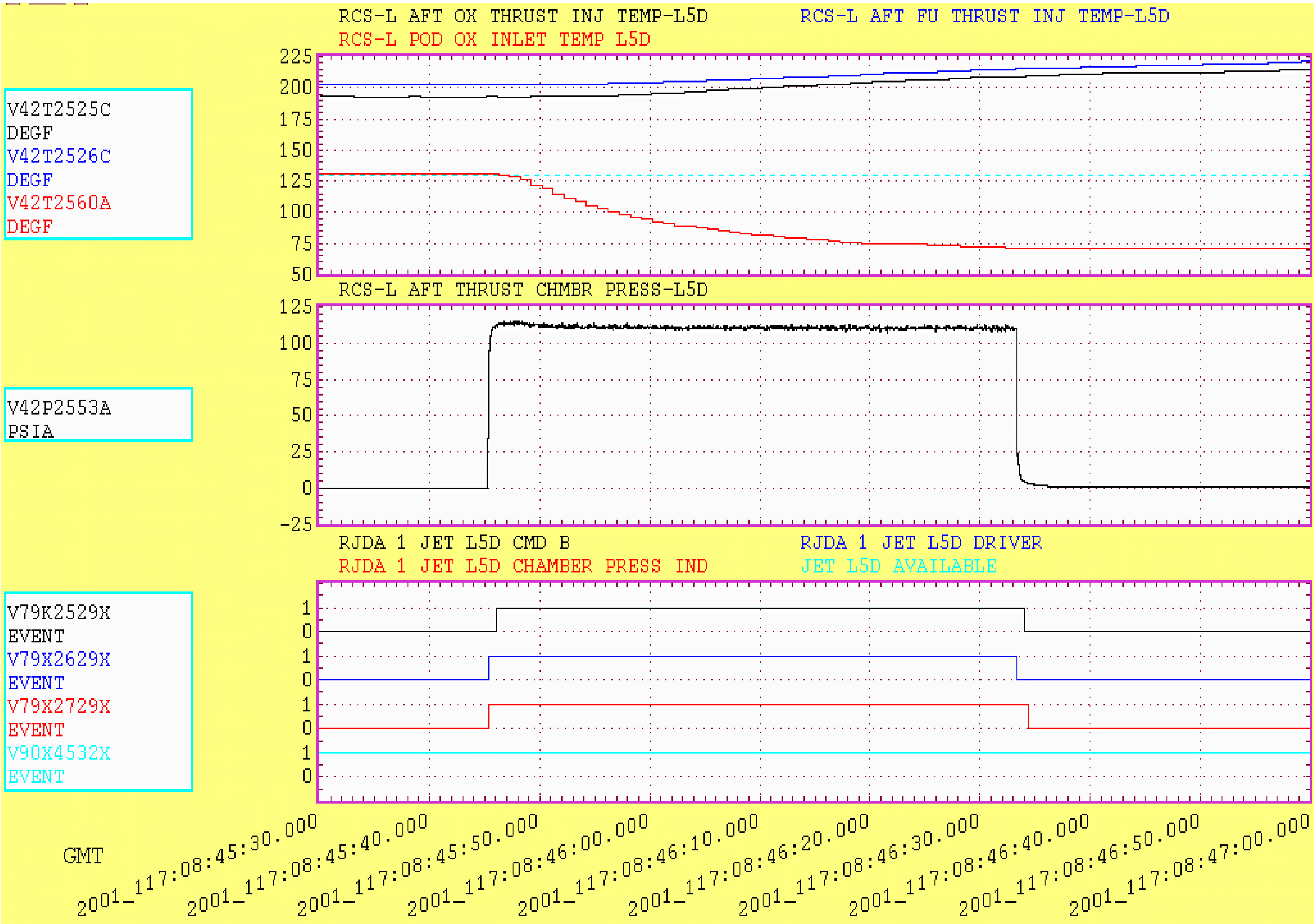
S/N	Pos.	Pod	Pulses	Burn Time (sec)	Thermal Cycles
401	-	-	**73,156**	**100,478**	**1,678**
403	F5L	FRC5	55,334	67,580	1,056
204	F5R	FRC5	0	0	0
611	L5D	LP04	49,342	62,409	845
108	L5L	LP04	80,310	72,391	894
101	R5D	RP01	35,736	40,881	653
306	R5R	RP01	72,225	63,084	966

STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE

Presenter:

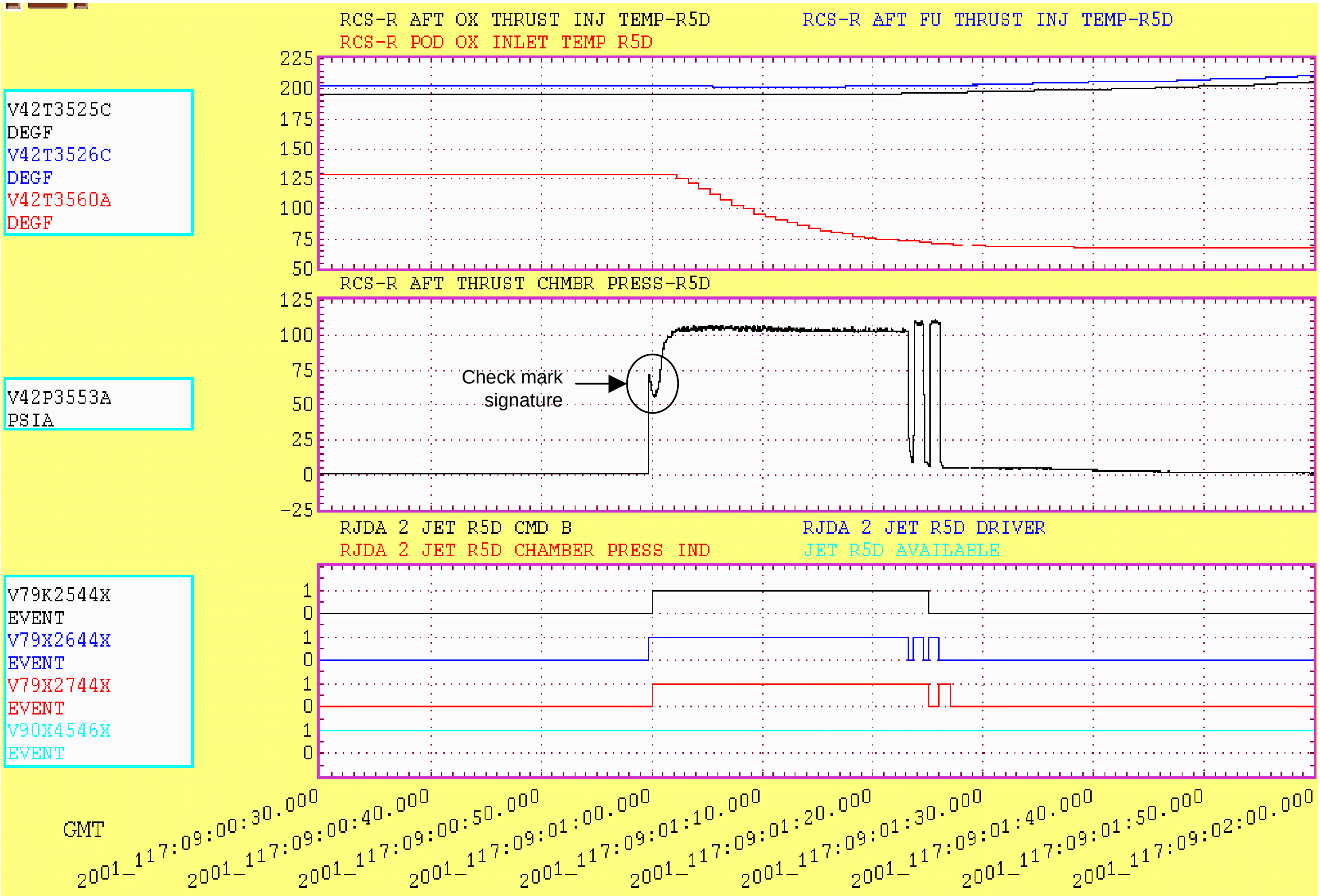
Organization/Date:
Orbiter/11-15-01

STS-100, L5D Firing After 72 hr Quiescent Period



STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE	Presenter:
	Organization/Date: Orbiter/11-15-01

STS-100, R5D Firing After 72 hr Quiescent

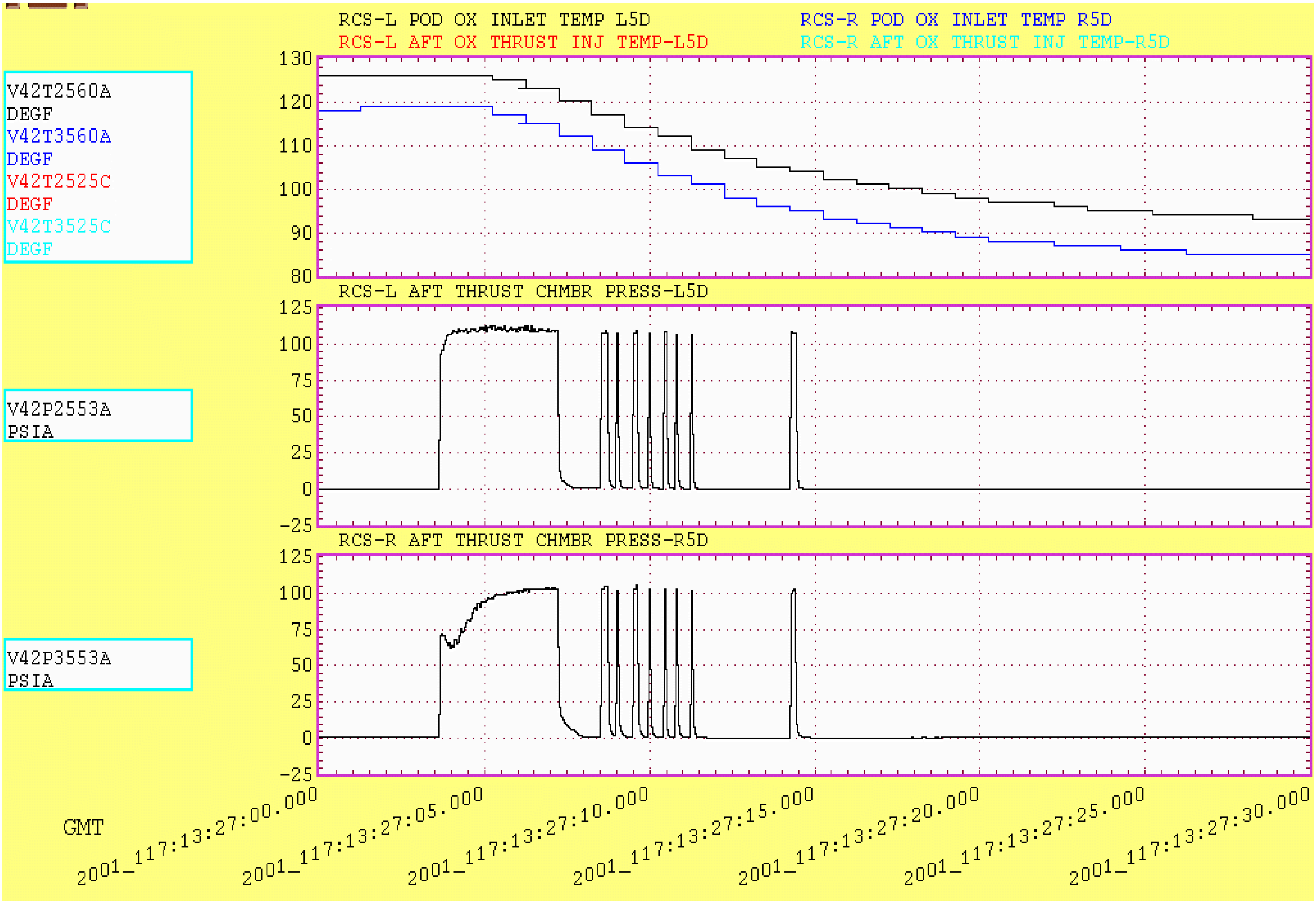


STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE

Presenter:

Organization/Date:
Orbiter/11-15-01

STS-100, R5D & L5D Firings 4 hrs After Previous Plots

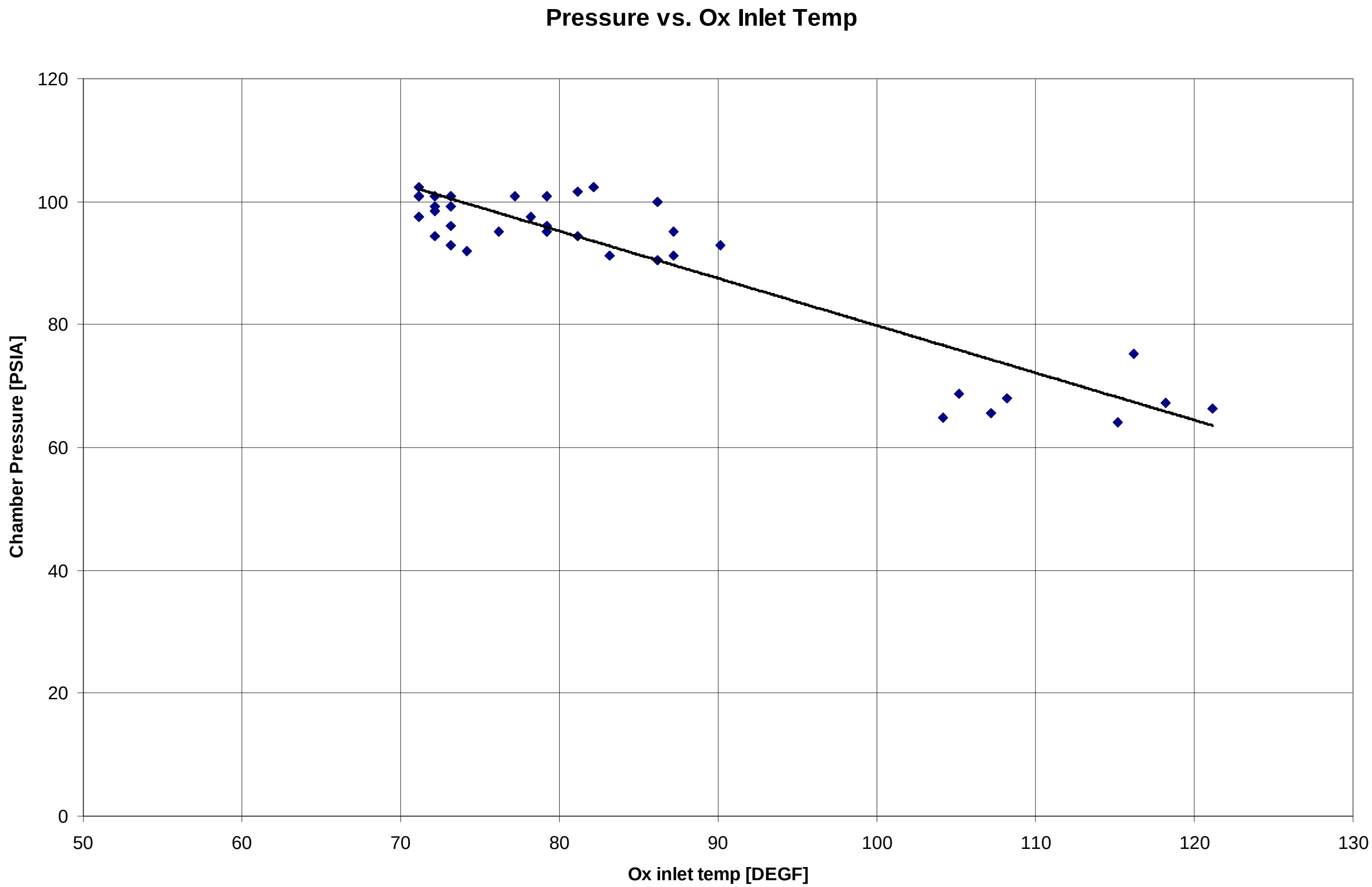


STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE

Presenter:

Organization/Date:
Orbiter/11-15-01

STS-100, Day 119, R5D Chamber Pressure vs. Ox Inlet Temperature

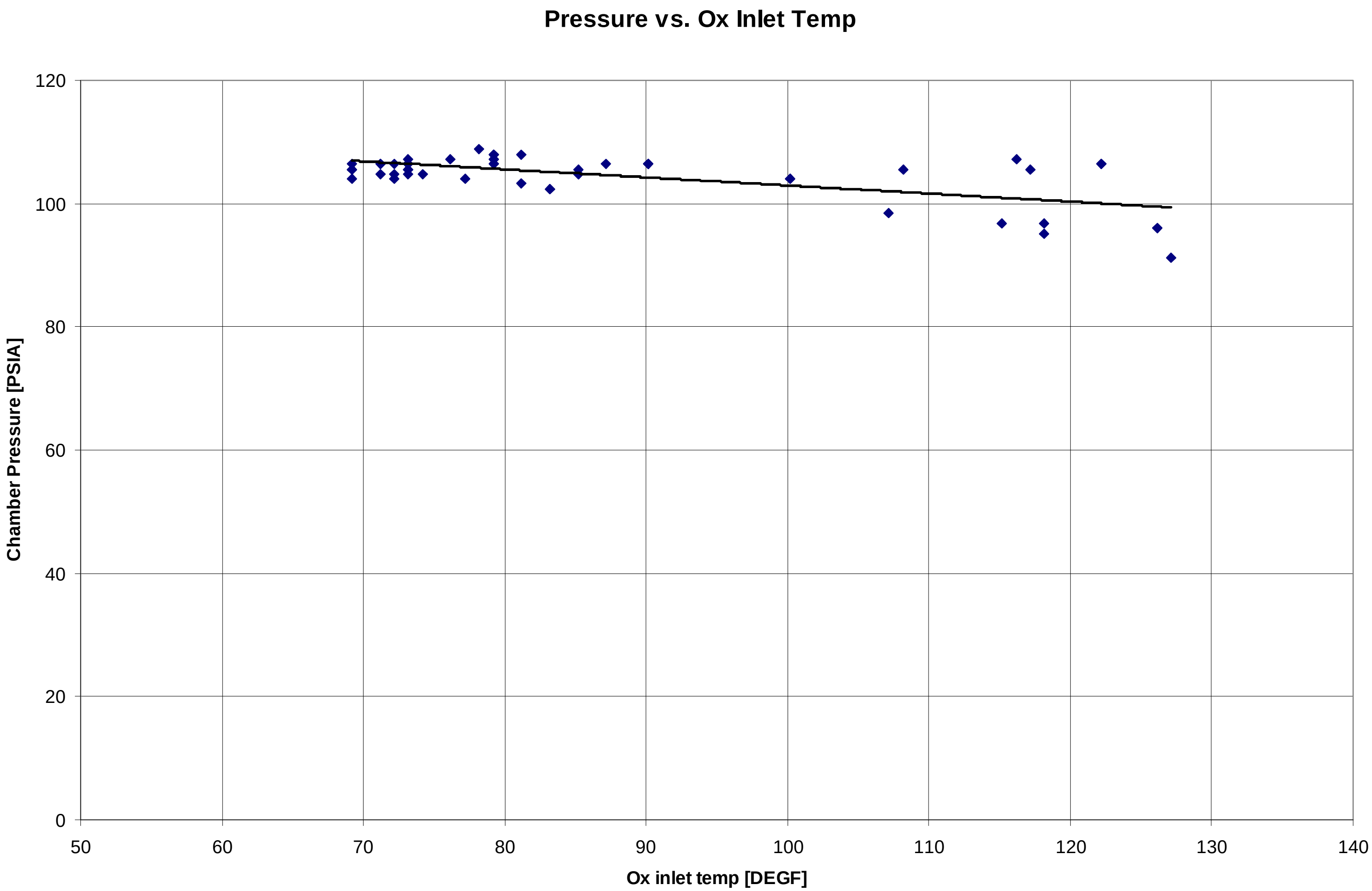


STS-100-V-04: VERNIER THRUSTER R5D INTERMITTENT LOW CHAMBER PRESSURE

Presenter:

Organization/Date:
Orbiter/11-15-01

STS-100, Day 119, L5D Chamber Pressure vs. Ox Inlet Temperature



	Presenter:
	Organization/Date: Orbiter/11-15-01

CONFIGURATION CHANGES AND CERTIFICATION STATUS

BACKUP

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/11-15-01

OV-105 STS-108 Modifications and Certification

Current Mission Requirements

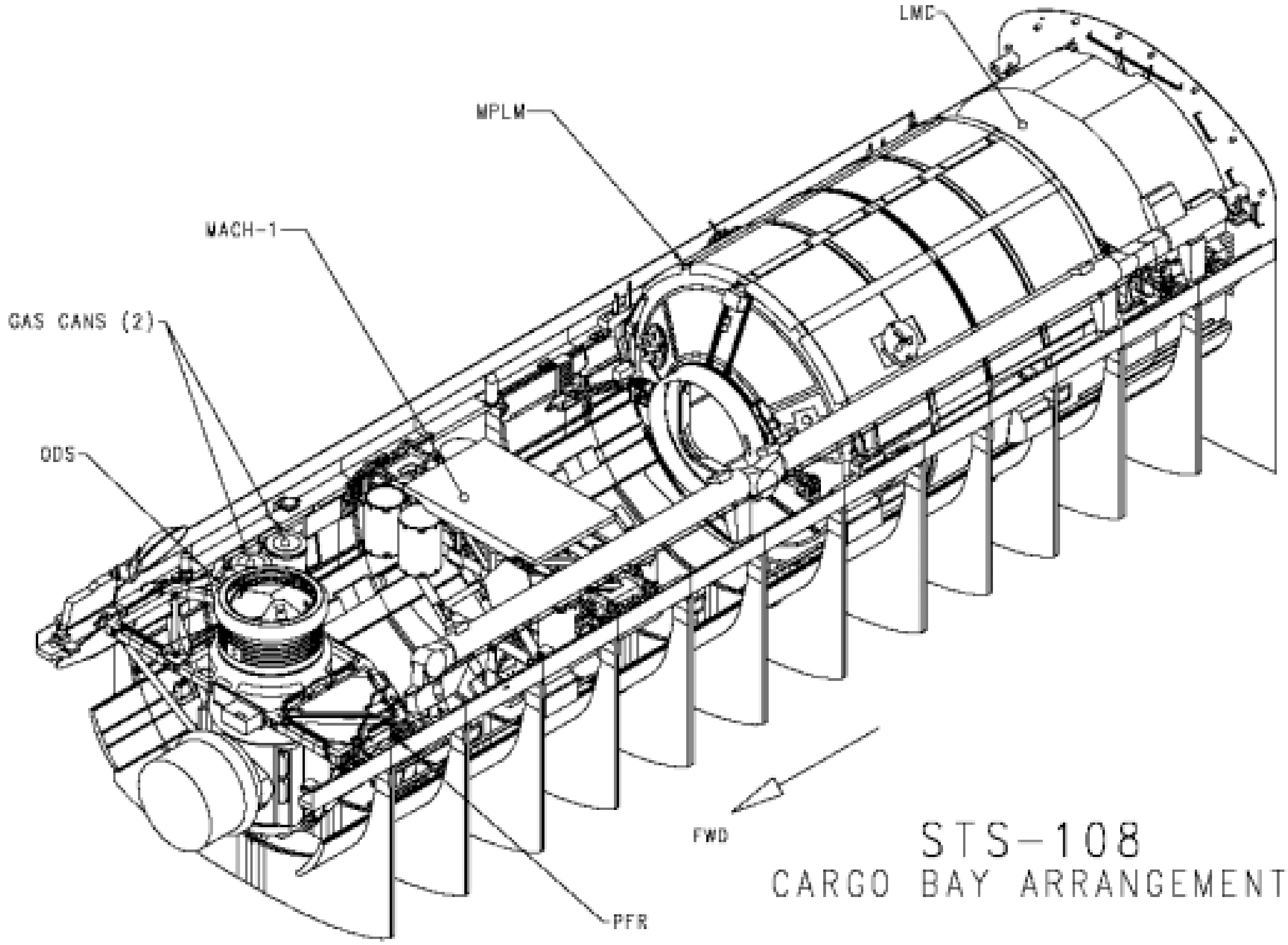
MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19563 SSME Thrust Structure Strain Gauge & Payload Trunnion Latch Accelerometer Instrumentation Mission Kit MVO886A FIRST FLIGHT				N/A *	N/A	* Boeing certification is not required. Micro-SGU and Micro TAU instrumentation and installation certified by GFE GCAR.

- Thrust Structure Micro-Strain Gauges Units (SGU):
  - Life analysis of orbiter primary structure to performance enhancement environments showed there are four aft fuselage titanium thrust structure components with life limitations
    - Engine 1, 2 & 3 pitch actuator fittings and the “upper beam”
    - Strut attach lugs on these components are critical
  - Fracture analysis conservatism will be validated using instrumentation flight data
  - Stand-alone Micro-SGU’s were installed at six locations on thrust structure struts which attach to these lugs to collect actual flight strain data to aid in the component life extension
    - The six locations have been instrumented by two strain gauges each with the measurements at each location recorded by a Micro-SGU recording unit (six locations, twelve total strain gauges, six Micro-SGU recording units)
- Payload Trunnion Latch Micro-Triaxial Accelerometer Units (TAU):
  - Uncertainties exist in the MPLM payload structural dynamic models and loads with respect to trunnion friction and slip dynamics
  - On-vehicle instrumentation will measure synchronized triaxial acceleration measurements at the payload trunnion and at the interfacing orbiter attachment latch
  - Stand-alone Micro-TAU units were installed at four obiter latch locations to record actual orbiter interface dynamics
    - Three locations associated with MPLM payload attach points - starboard forward (bay 8) and aft longeron (bay 12) latches and keel (bay 10) latch
    - One other location in the payload bay supports the MACH-1 payload - starboard forward (bay 5) longeron latch
  - Installation of the Micro-TAU on the payload is a payload integration responsibility

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/11-15-01



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Current Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19620 SSME HPFTP Vibration Measurement (Phase I / II)				N/A	N/A	• Info only - no associated orbiter mods. • New block II SSME high pressure fuel turbo pumps (HPFTP) experienced higher vibration levels than expected in ground testing. • As a result, the engine project desires to collect flight HPFTP vibration data to monitor engine health and reduce or eliminate engine removal for inspection / retest between flights • For phases I / II, the SSMEwill relocate their oxidizer pre-burner accelerometer to the HPFTP. • SSME instrumentation wiring runs to the same orbiter interface. • Phase I is for a single block II engine, phase II is for a full cluster of block II engines. • DCR4751 approved the instrument identification change to the MAST-II instrumentation database

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Future Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 18509 Condensate Separation and Collection		X		01C-23-623200-001C	10-12-00A	• ECLSS system certification
			X	05-35-643051-001D	08-01-01A	• ECLSS airlock mission kit system certification
Mission Kit MVO828A			X	02-22-621-0008-0007F	11-28-01A	• Water separator cert update
			X	04-24-271-0089-1004E	11-16-00A	• Flex hose certification
FIRST FLIGHT			X	05-24-271-0089-1004F	7-27-01A	• Flex hose certification update
			X	141-04-390001-001L	7-25-00A	• Structure certification

- Modification to the ECLSS waste management system which will allow condensate effluent to be separated from urine waste water
  - Provides the capability to collect the separated condensate in CWC's at a new, permanent crew interface point
- Mod driven by ISS requirement that Orbiter waste water dumps be inhibited during docked operations to preclude contamination of sensitive station components
  - Collecting condensate in CWC's increases the waste tank ullage available for urine, extending the time required between waste water dumps
- Mod involved laying in a new plumbing run to collect condensate from the humidity separator B test port and route it to a new collection interface QD in an existing middeck floor feedthru plate
  - Allows for easier crew access and setup for condensate separation operations by eliminating the need for the crew to access the ECLSS equipment bay and install and route a temporary DTO hose for condensate collection
- Mod also plumbs the humidity separator outlet line directly to the waste tank, eliminating its cross-tie to the urine waste water line
  - This allows the waste tank to be isolated, using the tank isolation valve, from the condensate line preventing waste urine from being introduced during condensate collection operations
- Middeck waste water subsystem switch panel ML31C was also modified with updated schematic nomenclature to reflect the subsystem modifications
- Modification installed this flow, but not planned for utilization.

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Future Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19484 Cargo PC Orbiter Scar Wiring FIRST FLIGHT				N/A *	N/A	* Previously certified materials and processes.

- Cargo PC is a flight reinvention activity, developed to decouple vehicle and cargo flight software reconfiguration
  - Utilizes portable general support computers (PGSCs) to provide software control and monitoring of payloads and payload functions
  - Reduces cargo software mission production template
- The Cargo PC system will interface with the orbiter GPC via payload MDMs PF1 and PF2 spare channels
- Implementation of Cargo PC involves orbiter scar wiring mods and payload integration wiring mission kits
  - Orbiter scar wiring installed this flow in the crew module from payload MDMs PF1 and PF2 in middeck avionics bays 1 and 2 to the payload station distribution panel (PSDP) on the flight deck
  - Payload wiring, to be installed at a later flight, will route from the orbiter interface at the PSDP to a PGSC interface in a flight deck payload interface panel (typical aft flight deck SMCH installation).

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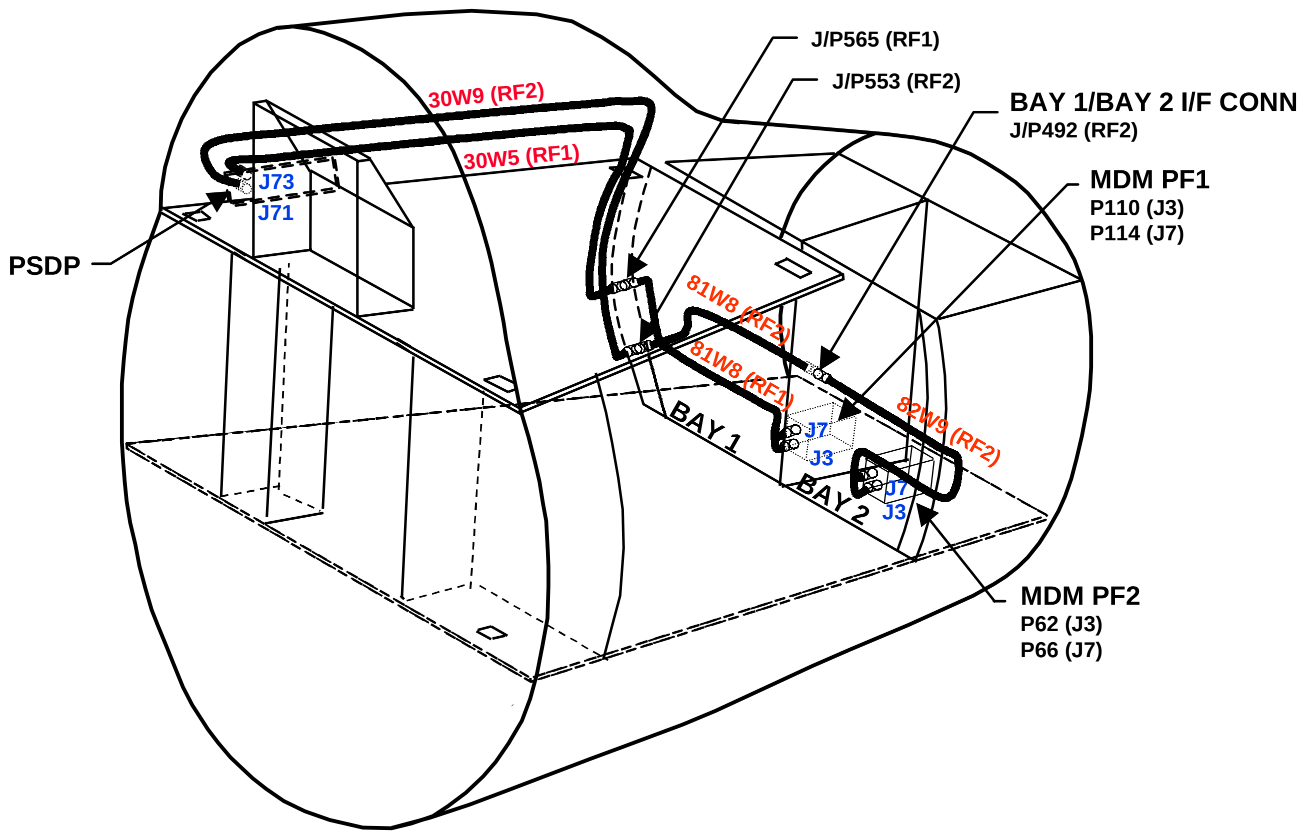
Cargo PC Wiring Diagram



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Corrective Action Mandatory

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19527 Critical Wire Redundancy Separation FIRST FLIGHT				N/A *	N/A	* Previously certified materials and processes.

- In 129 instances across the fleet, redundant wiring for crit 1 functions were routed together in common wire harnesses
  - 107 affected areas on OV-105 (OV-103 & subs) - 22 being unique to OV-102
  - Increased risk of system failure - loss of single wire harness could result in the loss of a critical function
  - Condition previously waived
- As part of the corrective actions from the fleet wiring investigation, it was determined these wires should be separated
  - Primary option was to separate redundant wires into separate existing or new harness runs
  - Secondary option was to separate redundant wires within a bundle using barrier material (i.e. convoluted tubing, teflon or mystic tape
  - Correction was not implemented if the determination was made that there would be significant risk to damaging wiring in the rework area versus benefit of the separation, or if major rework/redesign was required to accomplish(i.e. guillotines & hinged D&C panels)
- During this processing flow, 52 circuits were separated (32 crew module, 12 mid fuselage and 8 aft fuselage circuits)
  - The remaining 50, (49 in the crew module and 1 in the aft fuselage) will addressed at OMM
  - Note - During the flight 17 flow implementation it was determined that 3 of the “in flow” separations (2 in the crew module and 1 in the aft fuselage) were deferred to be worked with the OMM group due to the intrusive access required

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Corrective Action Mandatory

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19596 Separation of Inverter AC Wiring FIRST FLIGHT				N/A *	N/A	* Previously certified materials and processes.

- Redundant AC wire runs from the three crew module inverter distribution and control assemblies (IDCAs) in avionics bays 1, 2 & 3 to their respective circuit breaker panels, ML73C & L4, share common routing in twelve areas
  - Primary and secondary AC power could be lost due to a single event, resulting in loss of critical AC bus circuits
- This concern was readdressed as part of the fleet wiring investigation corrective actions
  - Redundant AC wiring in these twelve areas will be reworked as follows:
    - Rerouted into separate harness bundles and clamps (4 locations)
    - Where rerouting was not possible, separate or protect AC wire runs in the same bundle from each other using convoluted tubing (7 locations) or teflon tape (1 location)
- During this processing flow, nine of the twelve locations were reworked
  - The remaining 3 will be reworked at OMM due to the intrusive nature of access required

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 18872 Panel L4 Circuit Breaker Replacement FIRST FLIGHT				N/A *	N/A	* Previously certified materials and processes.

- Capability exists to isolate the radiators from the Orbiter freon loops should a freon leak develop in a radiator panel
  - Hardware mods including radiator panel isolation valves were installed in previous flows
- Documentation and closeout photo review during the OV-104 STS-104 flow revealed that panel L4 circuit breakers 137 and 138, which provide power to the two radiator panel isolation valves, were oversize
  - 5 amp circuit breakers installed, should be 3 amp
- Analysis showed that the maximum current draw allowed by a 5 amp circuit breaker could cause an over-current shut-down of its associated inverter if a short in the circuit were to occur downstream of the circuit breaker
  - “Race” condition would exist between the circuit breaker tripping off and the inverter over-loading
  - Loss of inverter output is classified as a criticality 1R3 condition
    - Associated 3 phase ganged circuit breakers are opened, causing loss of redundancy in multiple payload bay door latch gangs
    - However, IFM allows the shorted bus to be isolated from the 3-phase ganged circuit breakers
- During this flow, the 5 amp circuit breakers in positions 137 and 138 on panel L4 were changed out with the correct size 3 amp circuit breakers

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19605 **ODS Centerline Camera Harness Modification** **Mission Kit MVO828A**				**N/A ***	**N/A**	• STS-106 primary ODS centerline camera harness failure was found to be caused by a wire failure near one of three splice locations • The failure was attributed to the fact that the harness is flexed during handling, stowage and on-orbit installation, which causes stress at the splice locations • Splices utilized to reduce voltage drop • Harness modification relocates the three harness splices to be contained within the backshells, protected from flexure induced damage • The primary centerline camera harness was modified during last processing flow • The backup harness was modified during this processing flow * Previously certified materials and processes

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19652 Tissue Equivalent Proportional Counter (TEPC) Mounting Adapter Plate Mod FIRST FLIGHT			X	08-25-661612-001 G	10-29-01A	• TEPC panel certification • Shifts mounting hole pattern on the TEPC mounting adapter panel to eliminate an interference between the window shade assembly and the inboard side of the TEPC. • Interference caused by tolerance accumulation – combination of orbiter mounting hole locations, TEPC mounting adapter panel hole locations, TEPC units and window shade containers.
MCR 19541 Recumbant Mission Specialist Seat Configuration Upgrade Mission Kit MV0226A			X	01-25-39129802-301A	7/26/01A	• Provides new recumbent seat headrest cushions to allow height adjustability for different crew members

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19554 Elevon Flipper Door Trailing Edge Bulb Seal Mod (Attrition) FIRST FLIGHT				N/A	N/A	• Certification not affected • The flipper door inconel wire mesh bulb seals help close out the flipper door to rub panel interface surface • Aids in maintaining the shape and positive contact of the trailing edge seal to the elevon rub panel • These seals have a history of occasionally dislodged from their retainers and coming loose in flight • Could become lodged in the wing trailing edge mechanisms • Access and repair or replacement of loose or lost seals is a time consuming ground operations task • Modification corrects the condition by adding fasteners to mechanically hold the seal in position

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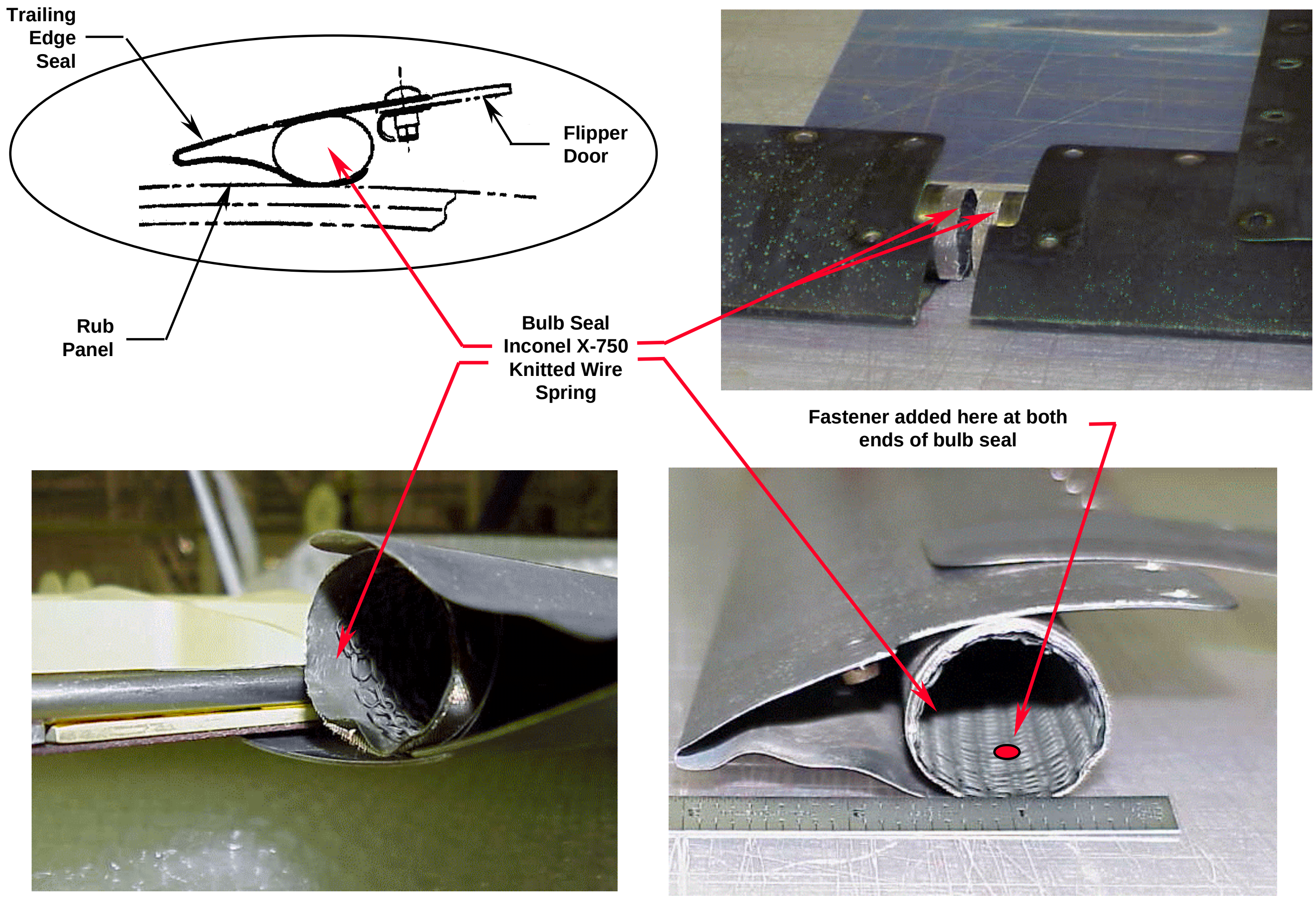
Elevon Flipper Door Trailing Edge Bulb Seal Mod



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OV-105 STS-108 Modifications and Certification

Corrective Action Optional / Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19531 ET Separation Camera Mod FIRST FLIGHT Mission Kit MV0456A		X X		163-03-350013-001K 163A-03-350013-001K	7-5-01A 10-19-01A	• Structural interface certification for new GFE cameras • Structural interface certification for single 16mm camera configuration • The 35 mm and 16 mm GFE ET umbilical separation cameras have been redesigned. • New cameras are heavier, requiring Orbiter structural interface verification analysis, as well as certification and ICD updates. • STS-108 will only fly the new 35 mm still camera. • The 16 mm cameras for this flight will be the old design • Boeing effort also included engineering changes to make the camera installation documentation consistent across the fleet. • Tech orders will be used to install the cameras to allow flexibility in camera manifesting • Vehicle engineering will install the camera all other Orbiter support hardware

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 12999 Wing to Fuselage Bolt Torque Change FIRST FLIGHT		X		159-02-340004-002M	8/21/01A	* Structural certification update

- The minimum class 3 torque requirement (1560 in-lbs) on a 9/16" RD111-4009-0936 wing-to-fuselage attach bolt at LH & RH Xo 1191 (1 on RH side, 1 on LH side) is less than the minimum torque required to prevent joint gapping (S/B 1570 in lbs)
  - The requirement is no gapping at limit load
  - There is high bolt positive margin, > 32% based on bolt material, however, bolt positive margin refers to static strength for a one-time load application
  - Bolt fatigue is affected when the applied load exceeds the pre-load, causing joint gapping.
    - The bolt cycles through a bigger stress range (max stress to min stress).
    - There is a compounding feature when the joint gaps, the joint can then "chatter", and this repeated opening and closing can wear on the joint face, accelerating the rate of loss of pre-load.
  - Increasing preload range to non-standard torque increases margin to prevent joint gapping.
- Mod engineering revises the torque range for these bolts from 1560-1680 in-lbs to 1580-1680 in-lbs
- This "mod" was worked in conjunction with the torque check requirement implemented per OMRSD RCN KV15506R1 approved 4/16/01

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19112 Wireless Video System (WVS) Antenna Ground Strap Trimming Mission Kit MVO874A				N/A	N/A	• Adds a 0.5" radius to the corners of ground straps associated with WVS antennas 1 & 7 to eliminate a sharp edge that could pose an EVA safety hazard • Antennas are mounted to the payload bay sill longeron • Ground straps for antennas 2-6 were reworked during the pevious (STS-100) processing flow
MCR 19376 Lightweight Locker Milson Fastener Mod Mission Kit MVO602A			X X X X X	02-25-000907-001A 03-25-660800-001B 07-25-661612-001F 09-25-660511-001H 16-25-661602-001N	6-25-01A 6-29-01A 7-5-01A 6-25-01A 6-25-01A	• Modification installs redesigned milson fasteners in the following components: • Lightweight middeck lockers • Thermal debris panels • Structural debris panels • Turnbuckles • Vehicle wire trays • Fasteners were modified to provide additional solid cross-section length to penetrate the vehicle wire tray shear plane • Restores capability of meeting the OVEI 20-g crash load requirement
		X		142-04-331002H	8-22-00A	

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 12999 Midbody Bay 2 RH Harness Installation Follow-on Mod				N/A	N/A	• Installs two 6 inch silicone strips which were deferred during an STS-100 wiring re-route that was required to resolve a GN2 tank installation interference
MCR 17177 Hydraulic Main Pump Mounting Washer Mod				N/A	N/A	• Installs larger diameter wahsers at the main hydraulic pump mounting flanges to minimize "coining" of the pump flange during bolt torquing
MCR 18755 External Airlock Bag/Strap Velcro Deletion Mission Kit MVO0828A			X	04-25-669-002025-001C	6-25-01A	• Deletes velcro which is no longer required on external airlock stowage bag pallet assembly straps
MCR 18755 Forward and Aft Winch Mod			X	09-25-650007-001M	7-5-01A	• Installs modified forward and aft GFE winches which incorporate new 4 ball pip pins and safety wiring

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Corrective Action Optional

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 18872 Radiator Isolation Switch Panel Nomenclature Change				N/A	N/A	• Certification not affected

- This MCR previously added radiator panel isolation capability to the freon loops in the event of damage resulting in leakage.
- Crew training revealed a potential for confusing the L1 switch panel nomenclature of the existing radiator bypass valve with the switch nomenclature added for the radiator isolation valve on adjacent panel L2A1 since both currently use the same terminology (‘BYPASS’) on the switch panel.
- As a temporary (flight 15 & 16) corrective action, the ‘BYPASS’ nomenclature was changed to ‘ISOLATE’ for the radiator isolation valve by installing a decal over the ‘BYPASS’ nomenclature on panel L2A1 to ensure that there is no confusion during mission operations.
- For flight 17, the long term corrective action was implemented by installing a new edge-lit panel with the nomenclature update

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Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19033 Orbiter Umbilical Plate Gap Delta Pressure Transducers FIRST FLIGHT		X X	X	01-10-415920-010 03-20-449-0178-0101D 03-14-271-0100-0001F*	7-27-01A 2-26-01A *	• MPS system certification • Pressure transducer certification * Note: Flex hose design previously certified per this CAR

- Modification installed a primary and redundant pressure transducers to measure purge pressure in the LH2 and LO2 ET/Orbiter disconnect plate gap.
  - Purge protects against hazardous gas ignition and GN2 or air intrusion which could result in icing of the electrical monoball, disconnect mechanisms or pyro bolt canister
- Provides direct and accurate verification of positive plate gap cavity purge during cryo loading
  - Secondary benefits of potentially identifying gross hydrogen or oxygen leakage in the umbilical area and provide correlation of plate gap conditions to aft helium concentration (largest component of aft helium concentration during cryo loading is from plate gap purge)
- Current method of monitoring plate gap purge only provides a gross indication that purge is flowing and is not sensitive to local system leaks which would could have a significant affect on plate gap purge
  - Requires lengthy operations to setup purge at Orbiter/ET mate
  - Drag-on pressure measurement installed at existing provision in electrical monoball
  - Purge is increased until proper plate gap pressure is achieved - this GSE purge pressure is recorded
  - LCC limit is based on a 25% drop in GSE supply pressure
- Modification utilizes an unused LH2 and LO2 umbilical electrical monoball GSE port as a permanent plate gap pressure tap site
  - A new flexhose and hardline ports the cavity pressure from each umbilical plate gap to two redundant pressure transducers mounted on structure just aft of the umbilical area
  - New wiring installed to route pressure transducer signals to the LH and RH T-0 umbilicals and will be picked up by the LPS (ground measurement only).
- Hardware installed this processing flow, but will not be active as the corresponding ground side modifications were not completed.
- The drag on purge set up and its associated LCC will be used with the new instrumentation for 4 flights to collect and evaluate comparative data.
  - Eventually the use of the drag on purge setup will be eliminated and, at that time, a revised LCC associated with the new pressure measurements will be put in place

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Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19533 ET Monoball Production Break FIRST FLIGHT		X		N/A * 162-03-350013-001K	N/A 5-25-01A	* Wiring - previously certified materials and processes. • Aft fuselage structure installation

- The harnesses routed to the LH2 and LO2 electrical monoball are in a high traffic area and therefore vulnerable to damage during ground processing operations
  - The harnesses are demated from the monoball for access to the area and temporarily stowed locally
  - Excessive and repeated flexing of the harnesses and exposure to incidental contact has resulted in wire damage
- Modification adds a monoball wiring production break
  - Existing wiring is shortened and terminated at the production break
  - New harness sections, routed from the production break to the monoball, allows this portion of the harness to be completely removed from the vehicle during turnaround processing
    - Eliminates damage concerns associated with temporarily stowing the harnesses and provides area access improvement
  - New “gang” wire harness retainer clamps facilitate wire harness removal and reinstallation
  - Three MPS helium lines were locally re-routed to allow room for the production break

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Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19518 APU Air Half Coupling Upgrade FIRST FLIGHT	X	X		01-16-276-0018-2453 17-09-061001AF	8-9-01A 10-31-01A	• Certification of Orbital Science air half couplings in APU system • Certification of associated TCS blanket modifications

- The Orbiter APU air half couplings (AHC's) used to service hydrazine fuel and GN2 have a history of poppet leakage
  - There are a total of six AHC's, three for fuel and three for GN2, one each for the three APU systems
  - The AHC's are located on the aft fuselage sidewall servicing panels AP56-01 and AP56-02
  - The existing design J.C. Carter AHC's have had a total of 72 R&R's since the start of the program
- Replacement of the J.C Carter AHC's requires an extensive amount of activity, including SCAPE ops in a limited work space area of the aft compartment
  - Potential of collateral damage to adjacent area subsystem hardware
  - The AHC has to be removed and sent to the HMF for poppet seal replacement
- Modification replaces the J.C. Carter AHC's with the more reliable Orbital Science AHC's
  - The Orbital Science AHC's are used in the OMS/RCS system and have required only 6 R&R's since return to flight
  - Additionally, the Orbital Science AHC's will eliminate the need for aft compartment scape ops should they require repair
    - The AHC poppet seal can be performed from outside the aft fuselage at the servicing panel without the need for recycling the hardware to the HMF for repair
- Ground side changes associated with the modification include Orbital Science ground half couplings and new scupper assemblies to accommodate the deeper QD

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Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19483 Body Flap Fitting Bolt Anti-Spin Retainer FIRST FLIGHT	X	X		159-03-350013-001K	4-3-01A	• Aft fuselage structural certification update

- The body flap attach fitting bolts are checked for torque loss after each flight and are re-torqued if bolt torque falls below allowed levels
  - These bolts are preloaded to maintain joint stiffness and prevent joint separation
  - There are four fittings with eight bolts, each attached to the lower aft fuselage
- Each flow, the body flap stub carrier and access panels are removed and the body flap positioned to allow access for personnel and tools to hold the bolt heads in position while the torque checks are performed on the fastener nuts in the aft fuselage
- The modification adds permanent bolt head retainers to the fittings, which restrain the bolts from turning
  - 17 of 32 bolt locations were modified this flow - the remainder will be worked at OMM
  - When completed, will significantly reduce the effort required to perform the torque check task and reduce the risk of access area collateral damage
  - Aft fuselage access only required to perform the torque checks

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Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19427 MPS/SSME Interface Pre-cast Foam Closeout (Attrition) FIRST FLIGHT				N/A *	N/A	* Previously certified materials. Pre-fabricated closeout meets intent of hardware and system certification

- The foamed 12” LH2 feedline (F1) and the 2” recirculation return line (F4.3) at the Orbiter / SSME interface is time and labor intensive task for both the installation and removal of the insulating foam
  - RTV applied over fasteners
  - Pour in place mold constructed
  - Hazardous operation requiring local clears when pouring foam
  - Removal is not only time consuming, but the process generates dust and contaminate in the aft fuselage around critical fluid interface areas
  - Performed each flow because of SSME removal and installation
- Design enhancement established pre-cast foam closeout sections for these joints
  - Sections are taped in place with LT-80 tape
  - Voids between the foam sections and the feedline are filled by injecting RTV through pre-drilled holes in the foam
  - Greatly enhances installation and removal process and time
- Design concept fit-checked at each engine joint location in OV-102 and OV-105
- Thermal characteristics verified at Stennis under cryo loading and engine firing conditions
- The new design is being flown on the engine 1 12” LH2 feedline (F1) joint for STS-108

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Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19309 Vertical Tail TPS Inspection Port Mod FIRST FLIGHT				N/A *	N/A	* Previously certified materials and processes.

- The vertical tail tip forward spar shear pin is inspected at interval per V30 structural inspection requirements
  - A fastener is required to be removed from the structure allowing access for borescope inspection of the shear pin
  - The fastener is located under the filler bar at two adjoining tile and removal of both tiles is required to access the area to remove the fastener
- Modification changes the local TPS tile configuration, making the footprint of one of these tiles large enough to incorporate a removable ceramic plug, integral to the tile
  - The removable TPS ceramic plug is located above the structural fastener, allowing the fastener to be removed to perform the structural inspection without tile removal
  - A total of four tile in this area were locally redesigned to accommodate the larger footprint tile

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MISSION KITS BACKUP

STS-108 MISSION KIT MODIFICATION SUMMARY	Presenter:
	Organization/Date: Orbiter/11-15-01

52 Orbiter Mission Kits Are Manifested (MECSLSI & CCCD) For STS-108:

- 5 STS-108 First Flight Mission Kit Related Modifications
  - MV0456A New GFE 35mm Umbilical Camera Manifested
  - MV0603A Volume B Locker Stowage Locker Configuration Without Liner (dry stowage use)
  - MV0828A ODS Mission Kit Hardware Affected by Condensate Separation Mod
  - MV0849A STS-108 Mission Unique Lightweight Starboard TSA Cushion
  - MV0886A Micro-SGU / Micro-TAU Instrumentation

# STS-108 MISSION KIT MODIFICATION SUMMARY	Presenter:
	Organization/Date: Orbiter/11-15-01

52 Orbiter Mission Kits Are Manifested for STS-108 (cont):

- 7 Mission Kit Related Modifications for STS-108 Previously Flown on Other Vehicles
  - MV0072P Modified GFE Portable Foot Restraint (PFR) - High Strength Bridge Clamp
  - MV0226A Recumbent Mission Specialist Seats Headrest Modification
  - MV0602A Lightweight Locker Milson Fastener Mod
  - MV0602A Fire Port Extension Hose Support Mod
  - MV0828A External Airlock Stowage Bag Strap Velcro Removed
  - MV0828A Modified ODS Centerline Backup Harness
  - MV0874A Wireless Video Antenna Ground Straps Modified to Eliminate Sharp Edges

- Detail listing of all manifested orbiter mission equipment kits and associated mission equipment modifications follows

STS-108 MISSION KITS

Presenter:

Organization/Date:
Orbiter/11-15-01

MISSION KIT	TITLE	COMMENTS
MV0072P	PAYLOAD / GFE INSTLS	- OSVS TARGET INSTL - MICRO WIS FOR FICS INSTL + MODIFIED PFR - HIGH STRENGTH BRIDGE CLAMP
MV0073A	PAYLOAD SUPPORT EQUIPMENT	
MV0074A	FERRY FLIGHT KIT	
MV0076A	ORBITER DOCKING SYSTEM MECHANISM	
MV0082A	REMOTE MANIPULATOR SYSTEM (RMS)	RMS INSTALLED THIS FLIGHT
MV0225A	CDR/PLT LW SEATS - COOLING UNIT MOUNTING BKTS (AFT/STBD) - FLT DATA FILE - EGRESS HANDHOLD	
MV0226A	M/S LW SEATS	+ RECUMBENT M/S SEAT HEAD REST MODIFICATION
MV0412A	S-BAND FM SYSTEM	
MV0418A	MCDS	
MV0424A	CIRCUIT BREAKER COLOR CODE KIT	
MV0439A	OV-105 MADS SYSTEM	
MV0456A	ET UMBILICAL CAMERAS	+ FIRST FLIGHT NEW RH UMBILICAL 35 MM STILL CAMERA - TWO OLD DESIGN LH UMBILICAL 16MM CAMERAS
MV0458A	EDO PALLET MISSION KIT PROVISIONS	
MV0465A	GN2 SUPPLY (NITROGEN TANKS)	- 6 GN2 TANKS - 1 REMOVED THIS FLOW - BAY 4 RH AFT

+ INDICATES MISSION KIT MOD

STS-108 MISSION KITS

Presenter:

Organization/Date: Orbiter/11-15-01

MISSION KIT	TITLE	COMMENTS
MV0485A	TACAN COOLING PROVISIONS	
MV0494A	GPS/INS DTO HARDWARE	SIGI/CRV INSTALLED WITH MAGR-S
MV0520A	PAYLOAD HEAT REJECTION (RADIATOR PANELS)	
MV0525A	PRSD SYSTEM TANK SET 4	
MV0529A	RENDEZVOUS AND DOCKING FLOODLIGHT	
MV0532A	PAYLOAD BAY LINER	PARTIAL INSTL UNDER BAYS 1 & 2 LONGERON BRIDGES
MV0544A	PRSD TANK SET 3	
MV0545A	COMSEC EQUIPMENT	
MV0546A	PRSD TANK SET 3 & 4 THERMAL CONTROL BLANKET KIT	
MV0548A	BULKHEAD CLOSED CIRCUIT TV	
MV0549A	PAYLOAD BAY FLOODLIGHTS	
MV0566A	PRSD TANK SET 5	
MV0568A	PROVISIONS STOWAGE ASSY (PSA) - HANDHOLDS & PFR	
MV0573A	AFT FUSELAGE BALLAST CONTAINERS	- NO BALLAST - CONTAINERS ONLY
MV0602A	LW STOWAGE LOCKERS	+ MILSON FASTENER MOD + FIRE PORT EXTENSION HOSE SUPPORT MOD
MV0603A	VOLUME A STOWAGE	+ NEW VOLUME B LOCKER CONFIGURATION WITHOUT LINER
	VOLUME B STOWAGE & ATTACH FITTINGS	

+ INDICATES MISSION KIT MOD

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STS-108 MISSION KITS

Presenter:

Organization/Date:
Orbiter/11-15-01

MISSION KIT	TITLE	COMMENTS
MV0606A	AIRLOCK STOWAGE KIT SERVICING & COOLING UMBILICAL	
MV0607A	SKY GENIE	
MV0610A	HAND CONTROLLER INSTLN	
	LWT SEAT FLOOR STUDS	
MV0611A	WINDOW SHADES	
MV0612A	MIDDECK STRUCTURAL CLOSEOUT KIT	
MV0617A	EVA SLIDEWIRE	
MV0622A	PAYLOAD BAY FLAG	
MV0627A	LIOH CONTAINER	
	MULT. HEADSET ADAPTER PLATE ASSY	
	CPU ORIFICE SCREENS	
	ON-ORBIT STATION STOWAGE LOCKER	
MV0643A	MMU ORBITER PROVISIONS KIT	
MV0645A	LW MAR DEBRIS CLOSEOUT	
MV0647A	VOLUME D STOWAGE CONTAINER	
MV0651A	EMERGENCY EGRESS SLIDE	

+ INDICATES MISSION KIT MOD

STS-108 MISSION KITS

Presenter:

Organization/Date:
Orbiter/11-15-01

MISSION KIT	TITLE	COMMENTS
MV0653A	SORG	
MV0655A	AV BAY WIRE TRAY SCAMP ASSY	
MV0657A	CABLE TRAY	
MV0669A	SLEEPING BAGS	
	LADDER	
	EMERGENCY EGRESS PLATFORM CUE CARD SUPPORT	
	WMC STOWAGE AND TRASH BAG	
	VOLUME 3B STOWAGE	
	INTERDECK LIGHT SHIELDS	
	STARBOARD MID DECK WALL AIR DIFFUSER BYPASS DUCTS	
MV0719A	**NOTE: PAYLOAD INTEGRATION AFT FLIGHT DECK AVIONICS KIT**	
	GFE WIRELESS VIDEO SYSTEM CONTROL PANEL INSTALLED IN THE	
	VIDEO PROCESSING UNIT (VPU)	
MV0827A	SPARE MCIU AND PDI	

+ INDICATES MISSION KIT MOD

STS-108 MISSION KITS

Presenter:

Organization/Date:
Orbiter/11-15-01

MISSION KIT	TITLE	COMMENTS
MV0828A	EXTERNAL AIRLOCK & PROVISIONS STOWAGE PALLETS & BAGS - DOUBLE SMALL PORT FLOOR BAGS - DOUBLE SMALL STBD FLOOR BAGS - DOUBLE SMALL PORT CEILING BAGS - DOUBLE SMALL STBD CEILING BAGS - EXTERNAL AIRLOCK STOWAGE BAG EMERGENCY EGRESS NET MIDDECK HANDHOLDS FIRE EXTINGUISHER ON-ORBIT BUNGEE ATTACH FITTINGS CLOSEOUT NETTING INSTL Xo 576 HATCH STRAP INSTL	+ EXTERNAL AIRLOCK STOWAGE BAG STRAP VELCRO DELETION + CONDENSATE SEPARATION & COLLECTION MOD MISSION EQUIPMENT MOD + MODIFIED ODS CENTERLINE CAMERA BACKUP HARNESS

+ INDICATES MISSION KIT MOD

STS-108 MISSION KITS

Presenter:

Organization/Date:
Orbiter/11-15-01

MISSION KIT	TITLE	COMMENTS
MV0849A	LW TOOL STOWAGE ASSY (PORT)	+ STS-108 CONFIGURATION LWT STARBOARD TSA CUSHION
MV0859A	MAR & PROVISIONS INCLUDES LOCKERS & ATTACH FITTINGS	LIGHTWEIGHT MAR
MV0874A	WIRELESS VIDEO SYSTEM	PAYLOAD BAY ANTENNAS & ASSOCIATED COAX CABLES + ANTENNA 1 & 7 GROUND STRAPS TRIMMED TO ELIMINATE SHARP EDGES
MV0886A	MICRO-WIS INSTRUMENTATION	+ FIRST FLIGHT MPLM PAYLOAD BAY LATCH MICRO-TAU ACCELEROMETERS & AFT FUSELAGE ENGINE STRUT MICRO-SGU STRAIN GAUGES

+ INDICATES MISSION KIT MOD

	Presenter:
	Organization/Date: Orbiter/11-15-01

SPECIAL TOPICS BACKUP

	Presenter:
	Organization/Date: Orbiter/11-15-01

RESOLUTION OF AMEC SAIL ANOMALIES BACKUP

RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

Organization/Date:
Orbiter/11-15-01

- AMEC S/N 10 failures experienced during SAIL burn-in testing in July 2001
  - Left SRB Ignition PIC Arm went off prematurely
  - Left SRB Ignition PIC Fire 1 did not come on
  - Left SRB Ignition PIC Fire 2 did not come on
  - Right SRB Ignition PIC Arm went off prematurely
- Additional potential failure indications found during data review of all EMEC/AMEC burn-in tests
  - SRB Separation PIC ARM and Fire outputs did not execute properly
  - ET/Orbiter Forward PIC Fire 1 did not turn on as commanded

RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

Organization/Date:
Orbiter/11-15-01

Summary of AMEC/SAIL Anomalies and Findings

No.	Description	S/N	Findings	Causes
1	Right SRB SEP Fire 1 and Fire 2 turned on at the same time the ARM command turned on.	3	Confirmed MEDAS BOB J8 pin g broken wire (Right SRB SEP return pin) - Sneak path between IEA and MEDAS.	SAIL Instrumentation
2	Right SRB SEP PICs (6) did receive ARM command but did not receive Fire 1 or Fire 2.	3	Confirmed MEDAS BOB J8 pin g broken wire (Right SRB SEP return pin) - Sneak path between IEA and MEDAS.	SAIL Instrumentation
3	MEDAS showed AMECs intermittently did not generate ET/ORB FWD Fire 1 command	2, 5, and 8	Confirmed a bent pin on SAIL MEDAS patch panel.	SAIL Instrumentation

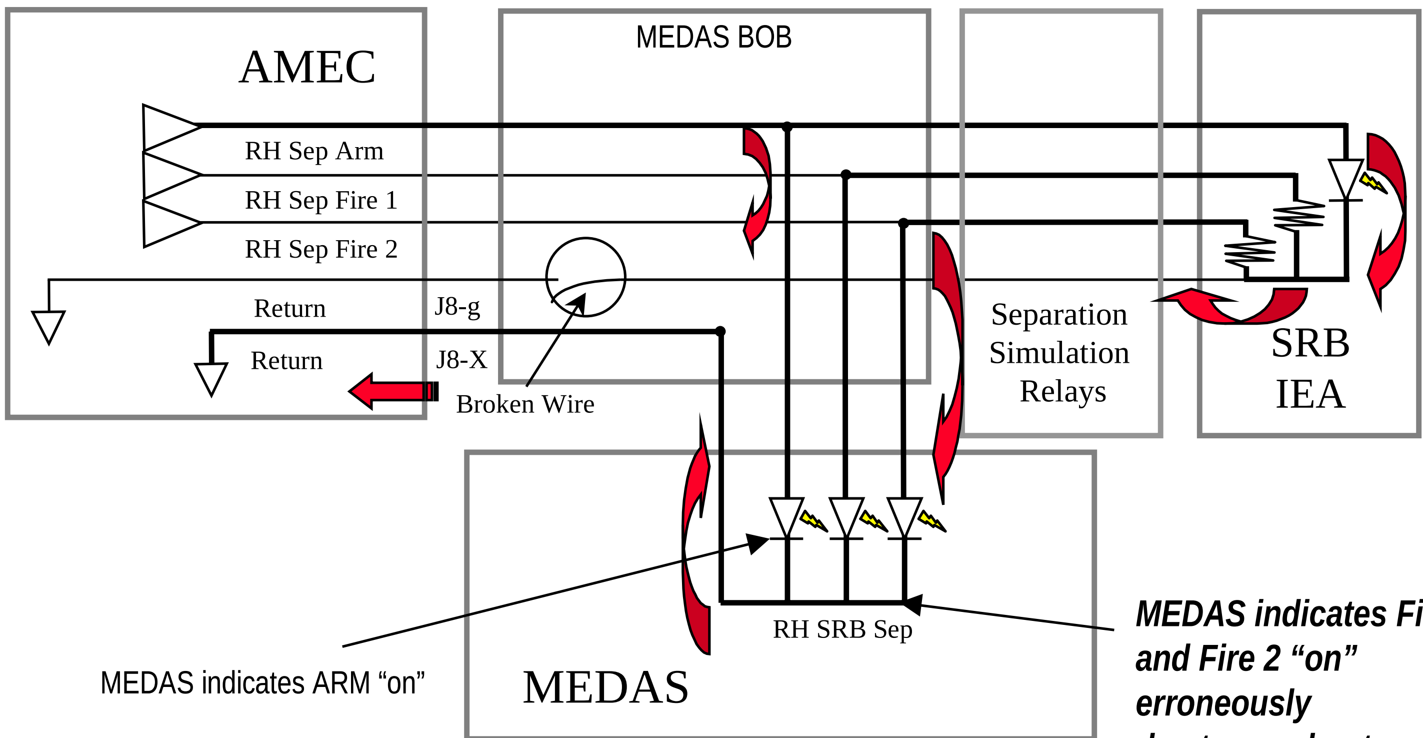
-MEDAS: Master Events Data Acquisition System
-BOB: Break Out Box

RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

Organization/Date:
Orbiter/11-15-01

Typical Sneak Signal Return Path - Simplified Diagram

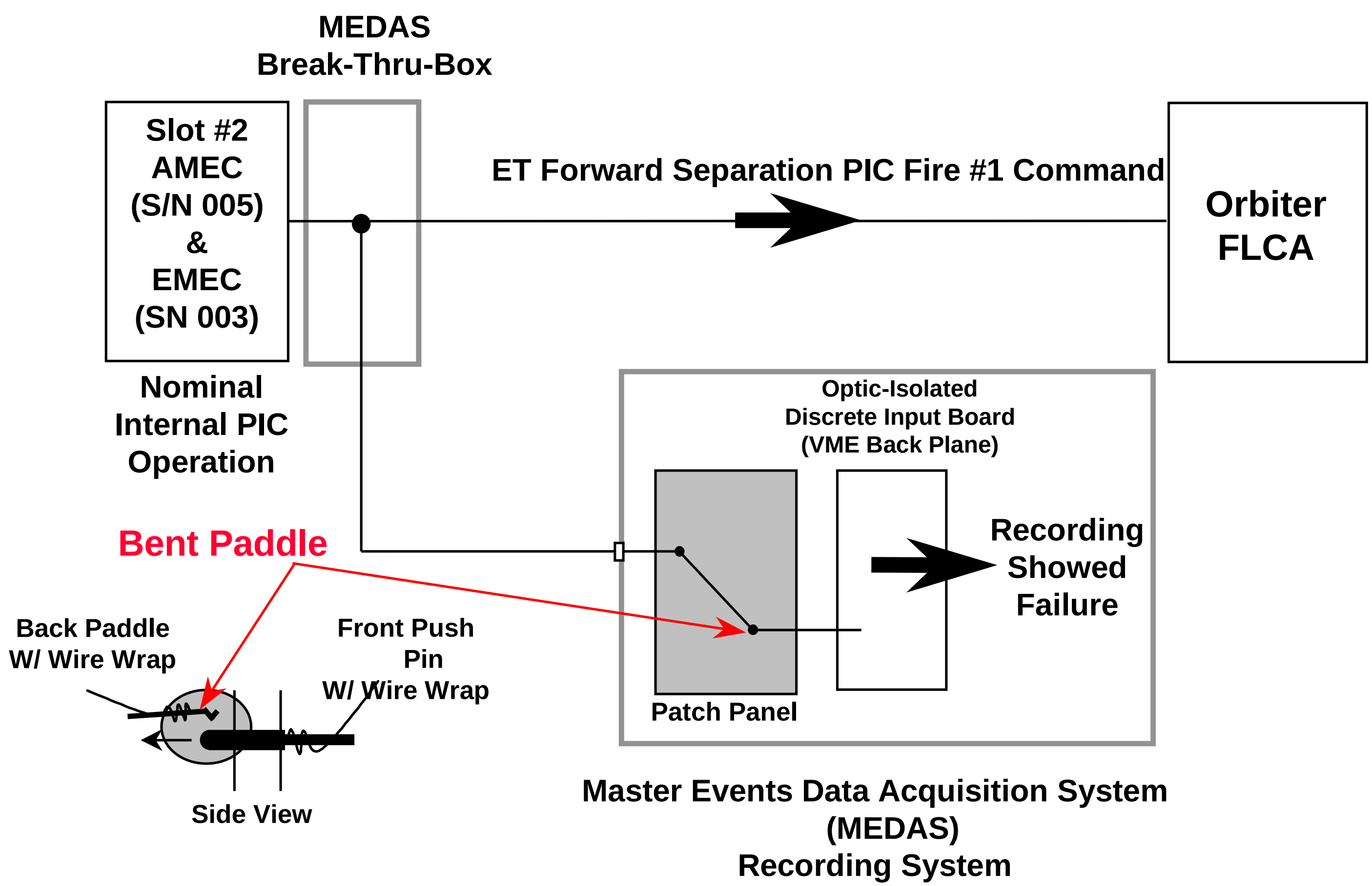


MEDAS indicates Fire 1 and Fire 2 “on” erroneously due to sneak return path

RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

Organization/Date:
Orbiter/11-15-01



RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

Organization/Date:
Orbiter/11-15-01

Summary of AMEC/SAIL Anomalies and Findings (Cont)

No.	Description	S/N	Findings	Causes
4	Left SRB IGN PIC ARM turned off prematurely.	10	Confirmed open ground pin J8-d failure on AMEC 10.	Loss of signal returns within the AMEC S/N 10.
	Left SRB IGN Fire 1 did not turn on.		Confirmed Unique SAIL instrumentation (MEDAS) uses AMEC J8-d as reference for these four left and right SRB IGN signals.	Confirmed that missing inductors is an isolated event and inspection escape which occurred during the initial manufacturing activities.
	Left SRB IGN Fire 2 did not turn on.			
	Right SRB IGN ARM turned off prematurely.		Confirmed missing ground path inductors within the AMEC S/N 10.	
5	Left SRB SEP Fire 1 and Fire 2 turned off prematurely.	10	Confirmed open ground pin failure on AMEC S/N 10.	Same as problem 4.

RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

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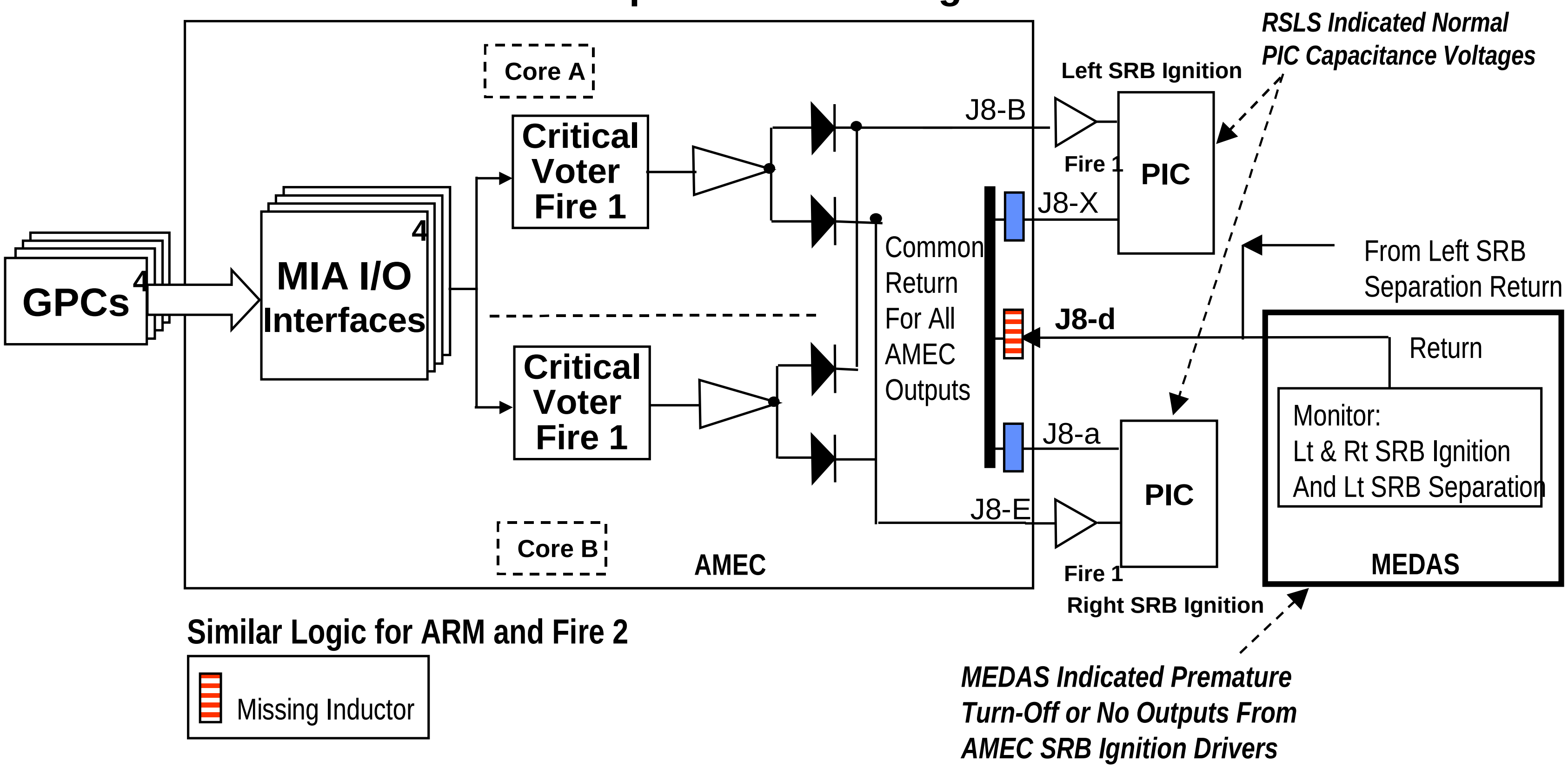
AMEC Fire 1 - SRB Ignition and MEDAS Instrumentation

Simplified Block Diagram



RESOLUTION OF AMEC SAIL ANOMALIES

Presenter:

Organization/Date:
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Summary of AMEC/SAIL Anomalies and Findings (Cont)

No.	Description	S/N	Findings	Causes
6	MEDAS showed AMEC S/N 10 generated proper left SRB SEP ARM commands but all 6 left SRB SEP PICs did not charge.	10	Confirmed open ground pin J8-d failure on AMEC S/N 10.	Same as problem 4.
			Confirmed Unique SAIL instrumentation (MEDAS) uses AMEC J8-d as reference for these four left and right SRB IGN signals.	
7	Pin-to-pin measurements showed J8 pins A, B, C, and D shorted together.	10	Confirmed AMEC executed PIC firing as commanded.	Most likely due to incorrect reading.
			Difficulty of obtaining data may have led to incorrect readings.	

	Presenter:
	Organization/Date: Orbiter/11-15-01

OMS POD ATTACH POINT #5 ANOMALY BACKUP

OMS POD ATTACH POINT #5 ANOMALY

Presenter:

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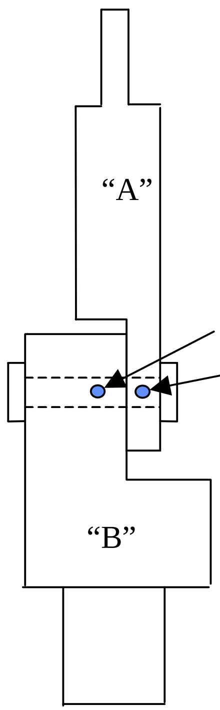
Set Up For Tests 4 Through 6

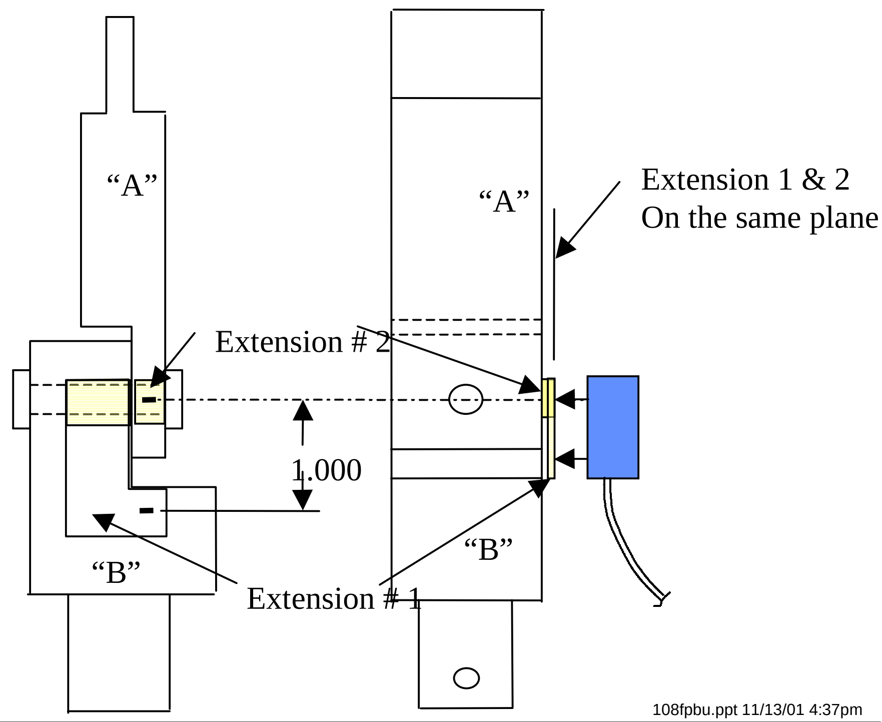
USING EXISTING TEST PLAN:

- ADD EXTENSIONS AS SHOWN BELOW
- ADD EXTENSIONOMETER AND ZERO, LOAD TWO TIMES TO 2000 LBS AND RESET TO "0.0" AT 500 LBS
- PULL AND RECORD DATA TO 10,800 LBS (approx. 90% of Failure load.)
- UNLOAD TO ZERO AND RECORD DISPLACEMENT
- THREE TESTS TOTAL

DESIRED RELATIVE DISPLACEMENT OF POINTS "A" AND "B" ON THE ATTACH CENTERLINE



BOND EXTENSION 1 ON TOP OF STANDOFF AT CENTERLINE TO PART "B", THEN BOND STANDOFF AND EXTENSION 2 TO PART "A"



OMS POD ATTACH POINT #5 ANOMALY

Presenter:

Organization/Date:
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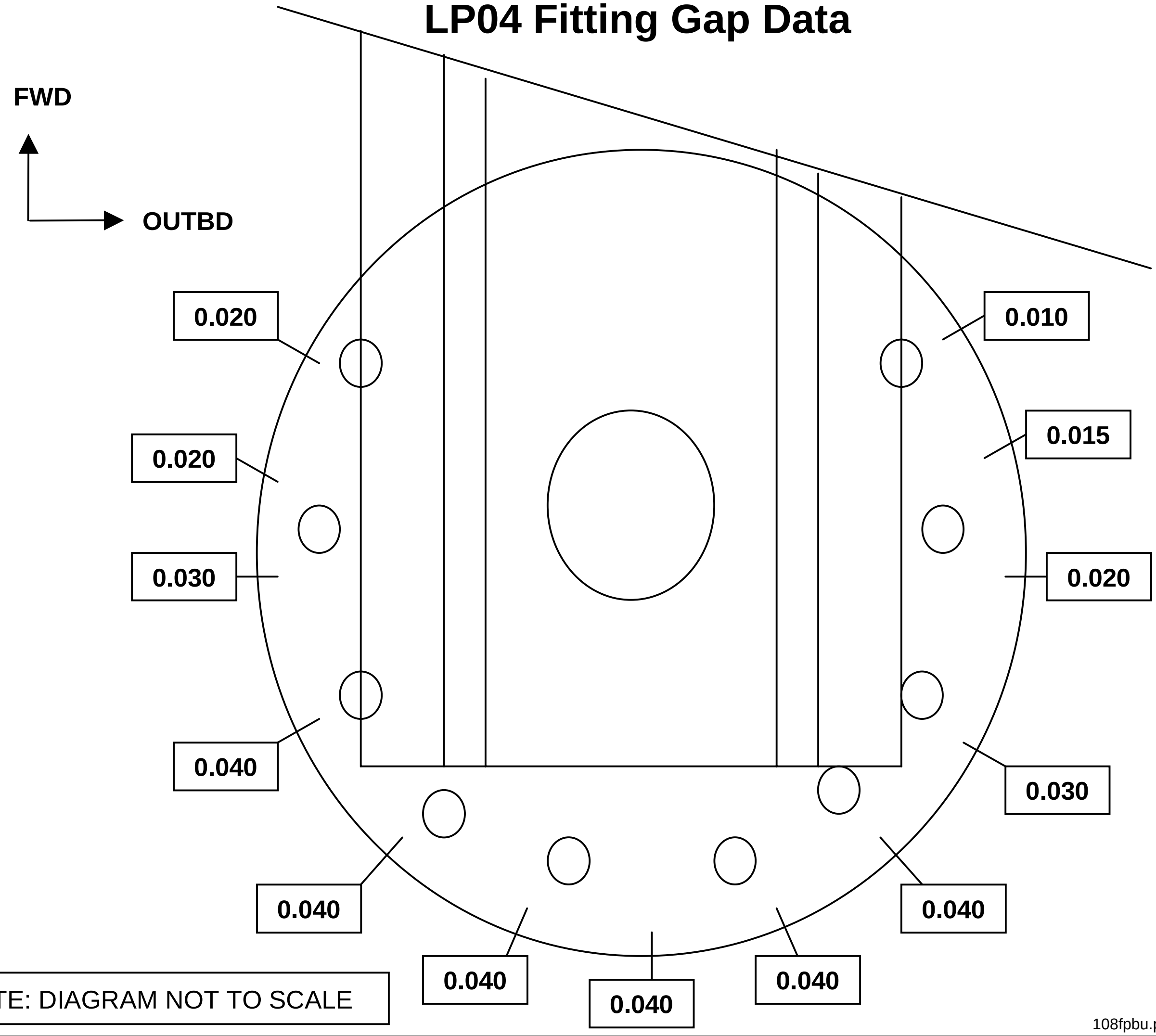
LP04 Fitting Gap Data



NOTE: DIAGRAM NOT TO SCALE

OMS POD ATTACH POINT #5 ANOMALY

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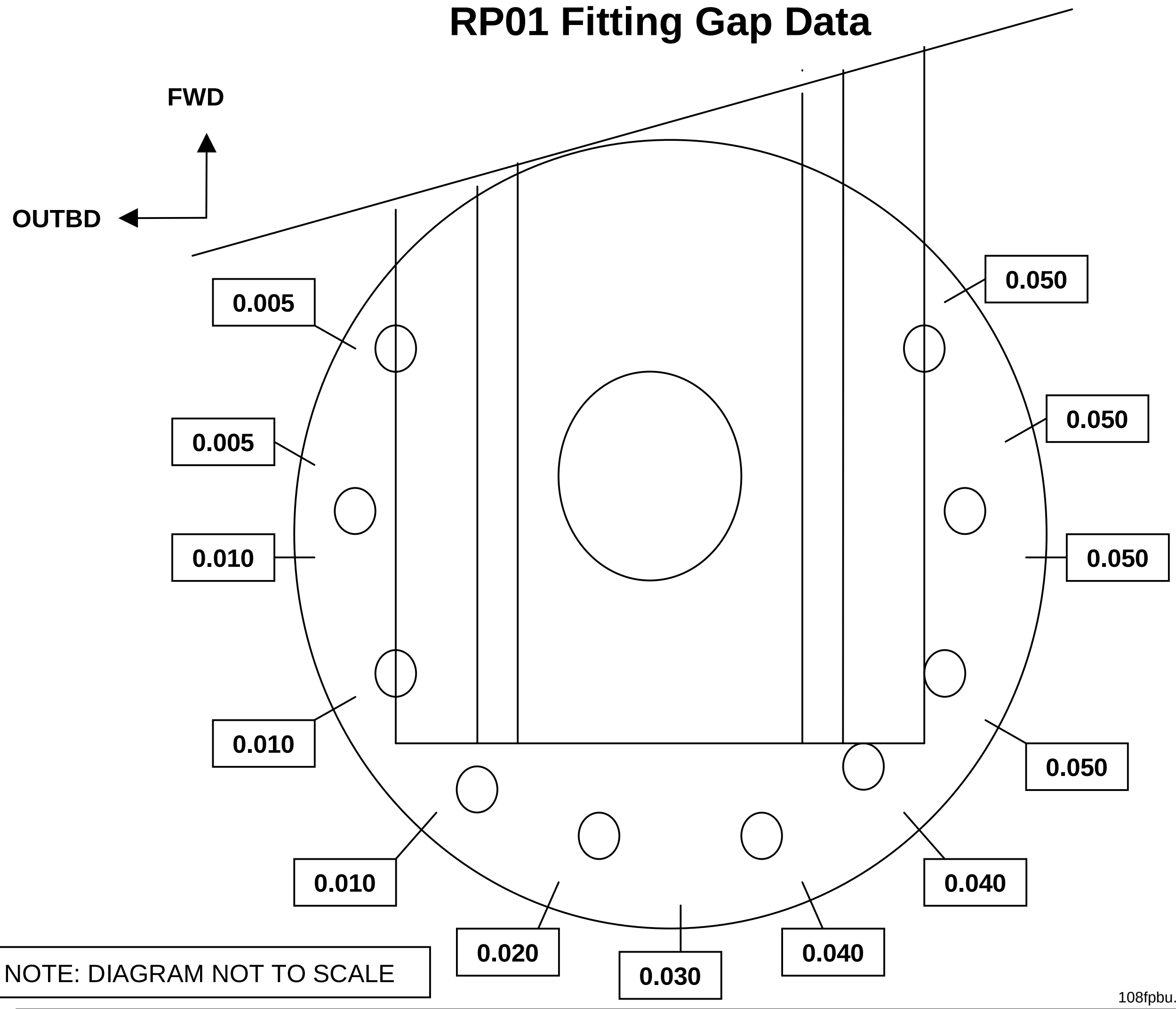
RP01 Fitting Gap Data



NOTE: DIAGRAM NOT TO SCALE

	Presenter:
	Organization/Date: Orbiter/11-15-01

VENT DOOR 8 & 9 ACTUATOR GEARBOX FOD BACKUP

VENT DOOR 8 & 9 ACTUATOR GEARBOX FOD

Presenter:

Organization/Date:
Orbiter/11-15-01

Ellanef Actuator Gearboxes Disassembled at NSLD

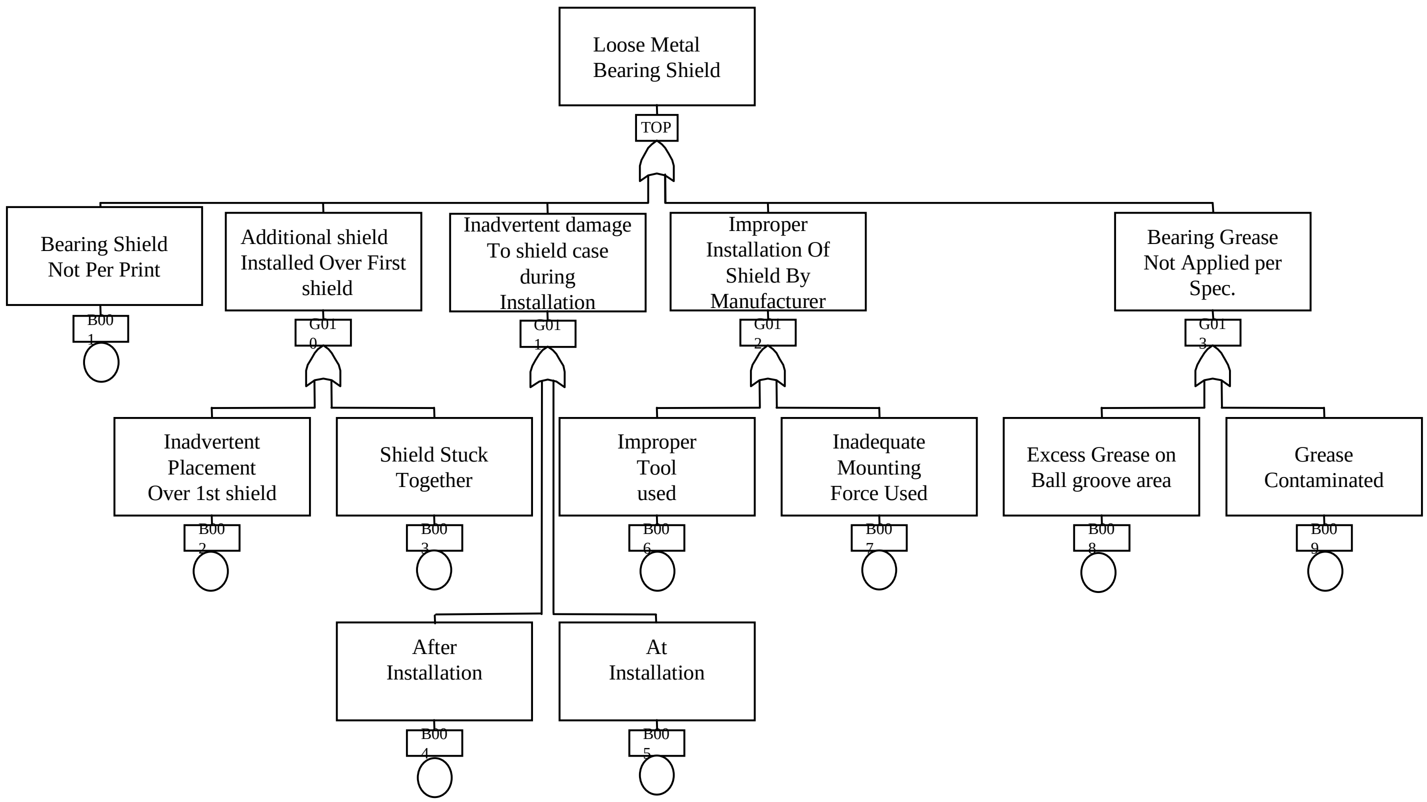
		Ellanef Actuator Repairs at the NSLD			
		(list limited to units whose gearboxes were disassembled)			
Part Number	Nomenclature	Serial #	PRR	Gearbox Disassembled	PRR date
MC147-0007-0007	Vent Door 3	SN 21	92378K	Yes	Jun-92
MC147-0007-0005	Vent Door 5	SN 5	90307L	Yes	Apr-94
MC147-0008-0014	Vent Door 8 & 9	SN 19	96915M	Yes	Dec 2000
MC147-0008-0013	Vent Door 8 & 9	SN 15	98432L	Yes	Jan-97
V070-591402-005	Z Startracker	OV-102 (1)	93715M	Yes	Dec-99
V070-591402-004	Z Startracker	OV-104 (1)	96734M	Yes	Dec-97
(1) Actuator serial number not available					

VENT DOOR 8 & 9 ACTUATOR GEARBOX FOD

Presenter:

Organization/Date: Orbiter/11-15-01

Fault Tree



	Presenter:
	Organization/Date: Orbiter/11-15-01

RUDDER SPEEDBRAKE PDU GEAR SCUFFING BACKUP

RUDDER/SPEEDBRAKE PDU GEAR SCUFFING

Presenter:

Organization/Date:
Orbiter/11-15-01

Summary of R/SB Motor Backdrive Events

Case:	Flight	Vehicle, flight #	PDU S/N, flight #	PDU S/N flights as of Oct 2001	PDU location as of Oct 2001	Flight Phase	Hyd. Sys.	Other active systems	MPS ISO valves	Duration (seconds)	Reason for system shutdown	Event stopped when:
1	STS-54	OV-105/3	407/3	8	OV-102	Ascent, MECO+6 min	3	1, 2	open	43	APU 3 bearing over-temp	iso valves closed
2	STS-54	OV-105/3	407/3	8	OV-102	Ascent, APU 1 shutdown (about 40 seconds after case 1 ended)	1	2	closed	1	Normal	System 2 shut down
3	STS-74	OV-104/15	403/17	22	Sundstrand	Ascent, hydraulic power-down	2	1(low), 3	closed	4	Normal	Systems shut down
4	STS-79	OV-104/17	403/19	22	Sundstrand	Ascent, post-MECO	2	1,3	open	23	Uncommanded (APU 2 miswire)	System 2 iso valve closed
**Case with data traces similar to backdriving (problem explained as stuck compensator stroking piston):												
5	STS-36	OV-104/6	403/8	22	Sundstrand	Entry, near entry interface	1	2,3	closed	350	Minimize leakage	No correlating event identified

RUDDER/SPEEDBRAKE PDU GEAR SCUFFING

Presenter:

Organization/Date:
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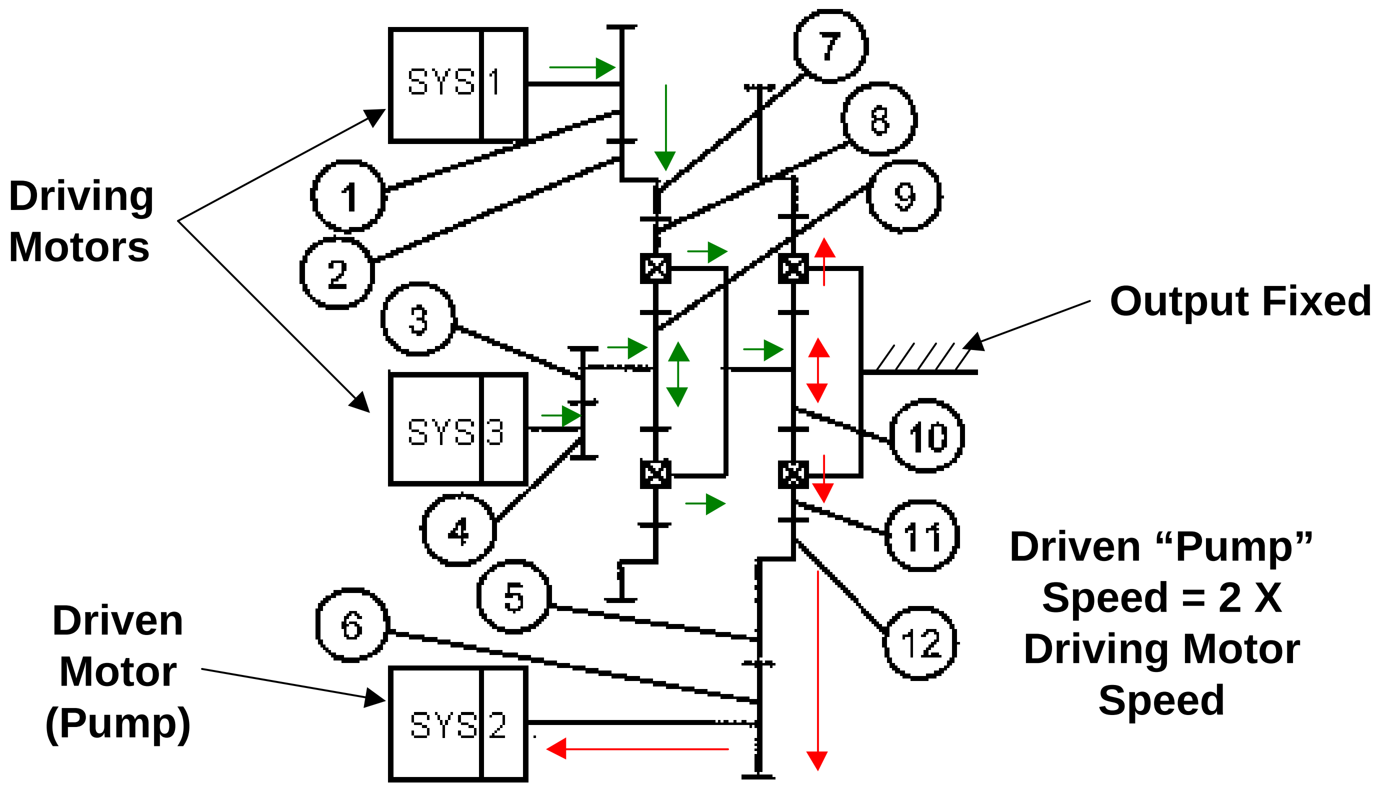
System 2 Backdriving Diagram



RUDDER/SPEEDBRAKE PDU GEAR SCUFFING	Presenter:
	Organization/Date: Orbiter/11-15-01

Scuffing Analysis Assumptions

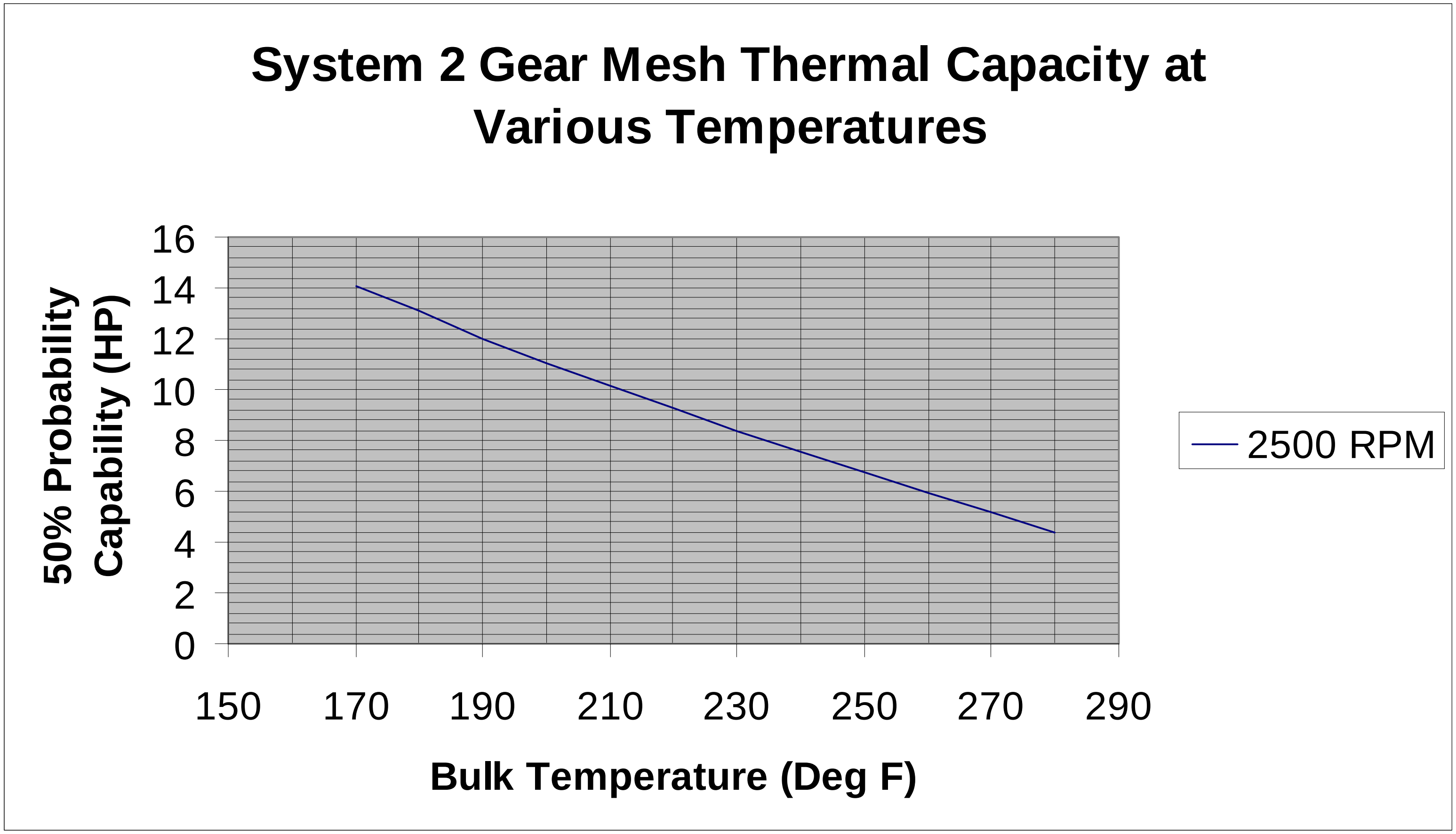
- Bulk Lubricant Temperature = 170ºF
  - Gearbox fluid enclosed, separate from supply/return fluid
  - No flight data available for gearbox fluid temperature
  - Used gearbox skin temperatures and increased 10°F
- Speed = 14,000 rpm
- Power = 50 HP (extreme case, no inefficiencies)

RUDDER/SPEEDBRAKE PDU GEAR SCUFFING

Presenter:

Organization/Date:
Orbiter/11-15-01

Temperature Sensitivity



RUDDER/SPEEDBRAKE PDU GEAR SCUFFING	Presenter:
	Organization/Date: Orbiter/11-15-01

Transient Analysis Results

Transient Acceleration

- Assumed "pump" speed = 14,000 rpm
  - Maximum rate for 2 driving motors is 7,000 rpm
- Acceleration time (approx.)
  - Depends on assumed pump outlet pressure
  - 0.06 sec using 1500 psi outlet
  - 0.16 sec using 2000 psi outlet

Temperature Rise:

- Starting Bulk Temperature 170°F
- 180 ºF increase in temperature at tooth interface due to Power and Speed
- Total Temperature = 350ºF

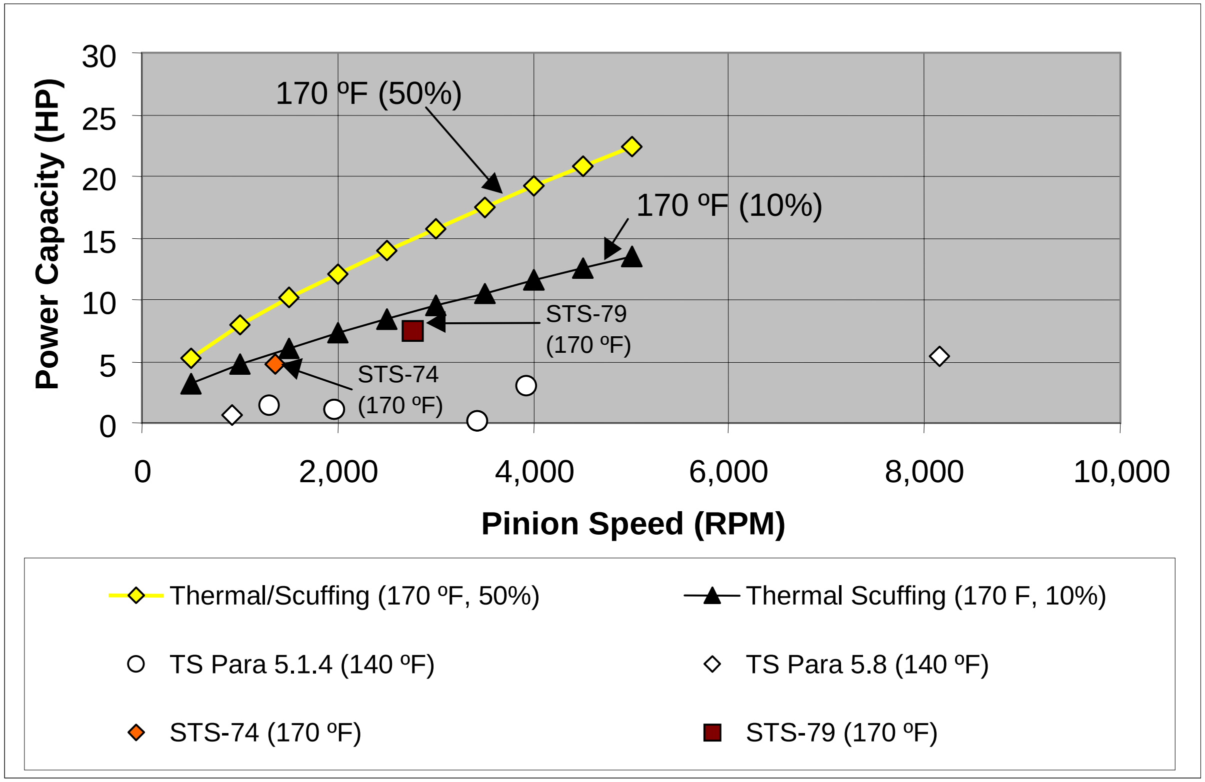
Scuffing Risk at 370ºF is approximately 50%

Scuffing probability during transient is significantly higher than at any other operating condition

- Cold scuffing
  - Onsets on a couple of teeth, then hunting ratio will damage other teeth
  - No technique available to analyze probability

RUDDER/SPEEDBRAKE PDU GEAR SCUFFING	**Presenter:**
	Organization/Date: Orbiter/11-15-01

System 2 Backdriving Probability Analysis
(Steady-State STS-74, STS-79, ATP)



- Scuffing limits for 10% & 50% probability assuming a 170 ºF bulk temp
- Scuffing design limit 50% probability

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RUDDER/SPEEDBRAKE PDU GEAR SCUFFING

Presenter:

Organization/Date:
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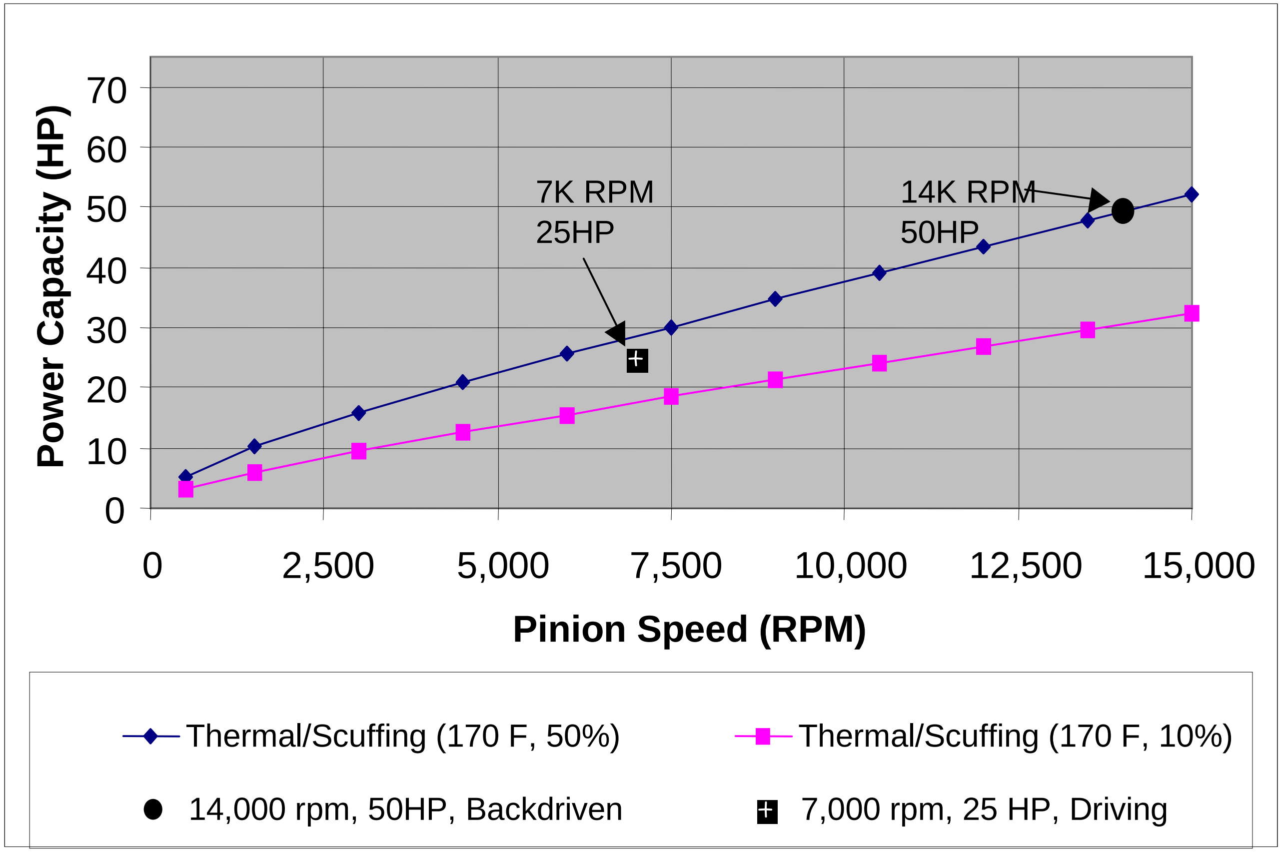
System 2 Backdriving Probability Analysis
(Worst-case Transient Cases)

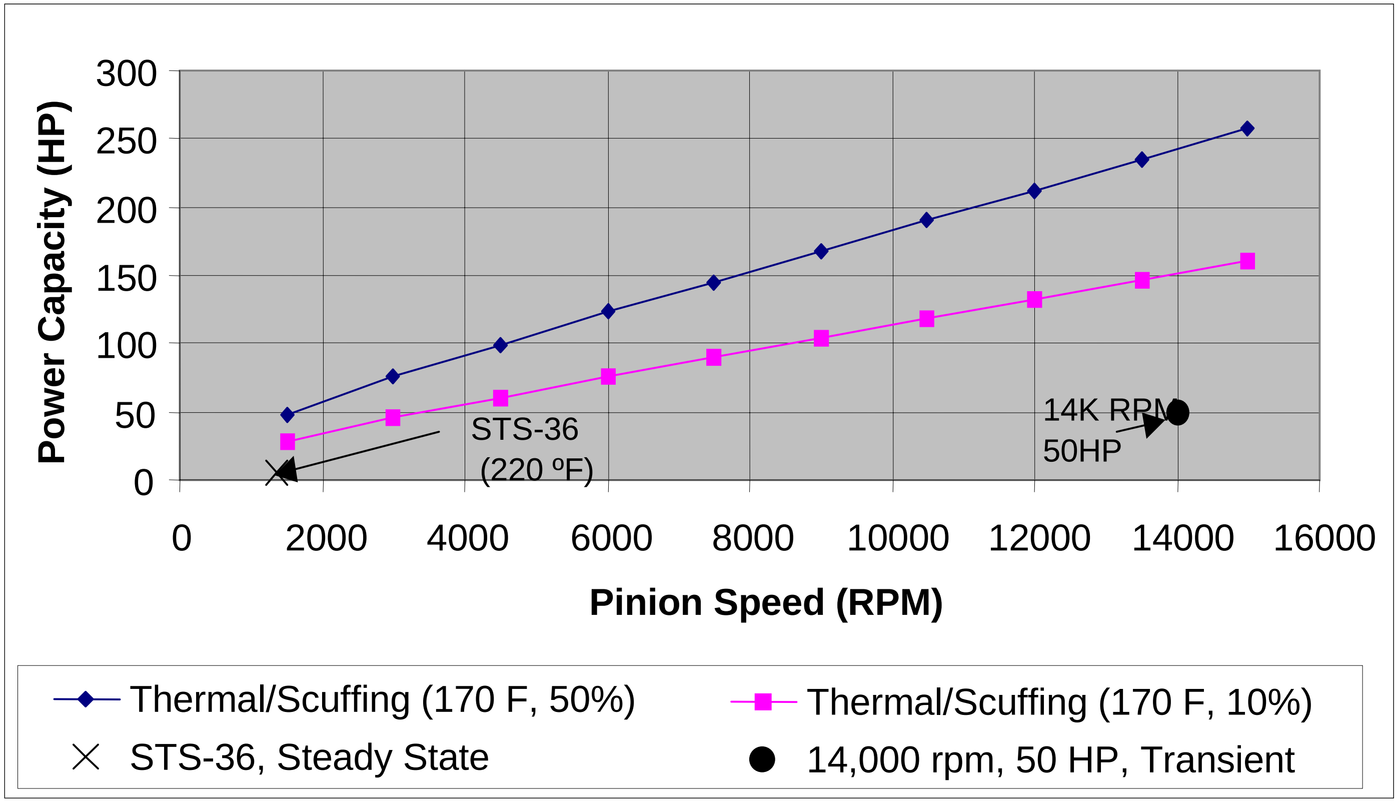


RUDDER/SPEEDBRAKE PDU GEAR SCUFFING

Presenter:

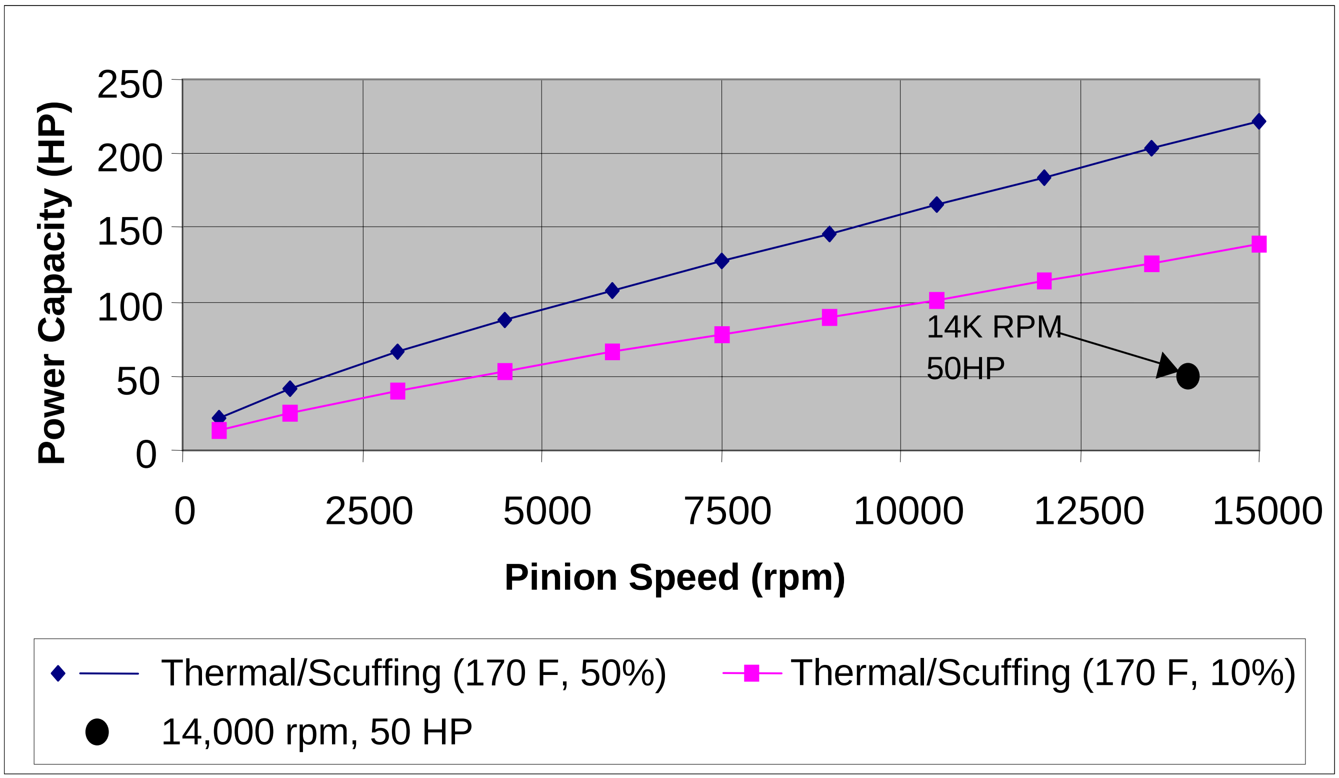
Organization/Date:
Orbiter/11-15-01

System 1 Backdriving Probability Analysis
(STS-36 Steady-State & Worst-Case Transient)



RUDDER/SPEEDBRAKE PDU GEAR SCUFFING	Presenter:
	Organization/Date: Orbiter/11-15-01

System 3 Backdriving Probability Analysis
(Worst-Case Transient)



	Presenter:
	Organization/Date: Orbiter/11-15-01

MLG WHEEL TIE-BOLT HOLE CORROSION BACKUP

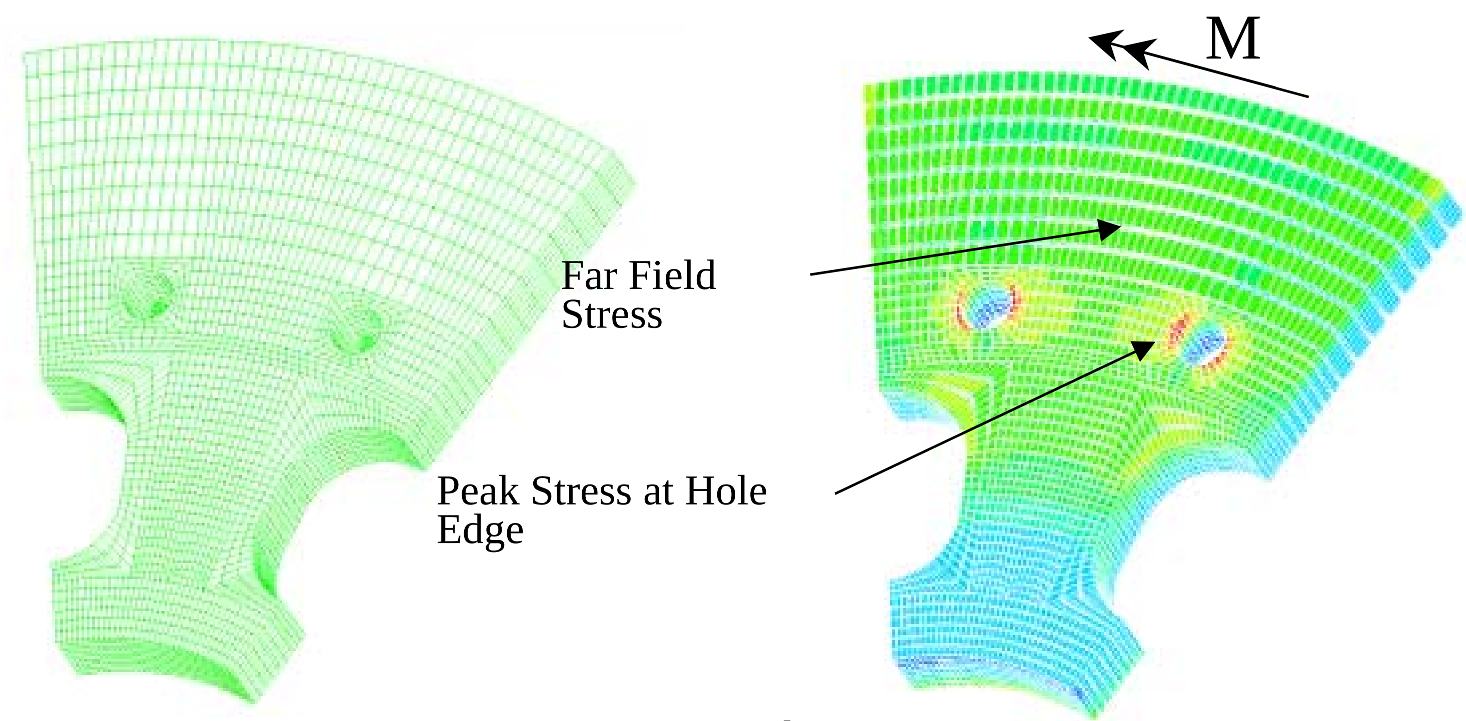
MLG WHEEL TIE-BOLT HOLE CORROSION

Presenter:

Organization/Date:
Orbiter/11-15-01

Preliminary Run with Stress Ratio = 3.0 Not representative of wheel

- Built simplified finite element model of segment of wheel, including spoke cut-outs
- Stress patterns examined to determine ratio of far field to peak stress at hole edge, and gradient between holes
- Bending stress distribution shows ~2.3 ratio



Bending Stress on Inner Face - Max Principal

MLG WHEEL TIE-BOLT HOLE CORROSION

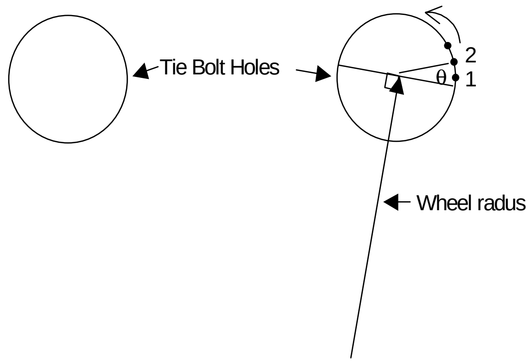
Presenter:

Organization/Date:
Orbiter/11-15-01

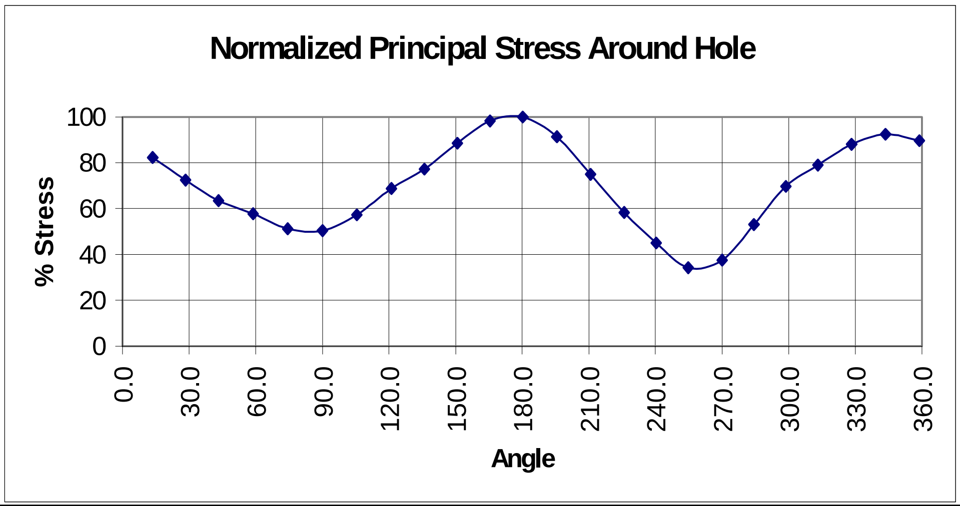
Principal Stress Peaks at ~180° Around Hole

- Measured from perpendicular to wheel radius through hole

Point	θ	Normalized Stress
1	13.7	82
2	28.4	72
3	43.2	64
4	58.8	58
5	74.4	51
6	90.0	50
7	105.6	57
8	121.2	69
9	136.0	77
10	150.8	88
11	165.6	98
12	180.3	100
13	195.6	91
14	210.8	75
15	226.0	58
16	240.4	45
17	254.8	34
18	270.0	38
19	284.4	53
20	298.8	70
21	313.2	79
22	328.4	88
23	343.6	92
24	358.9	90



View Looking at Inner Face of Wheel



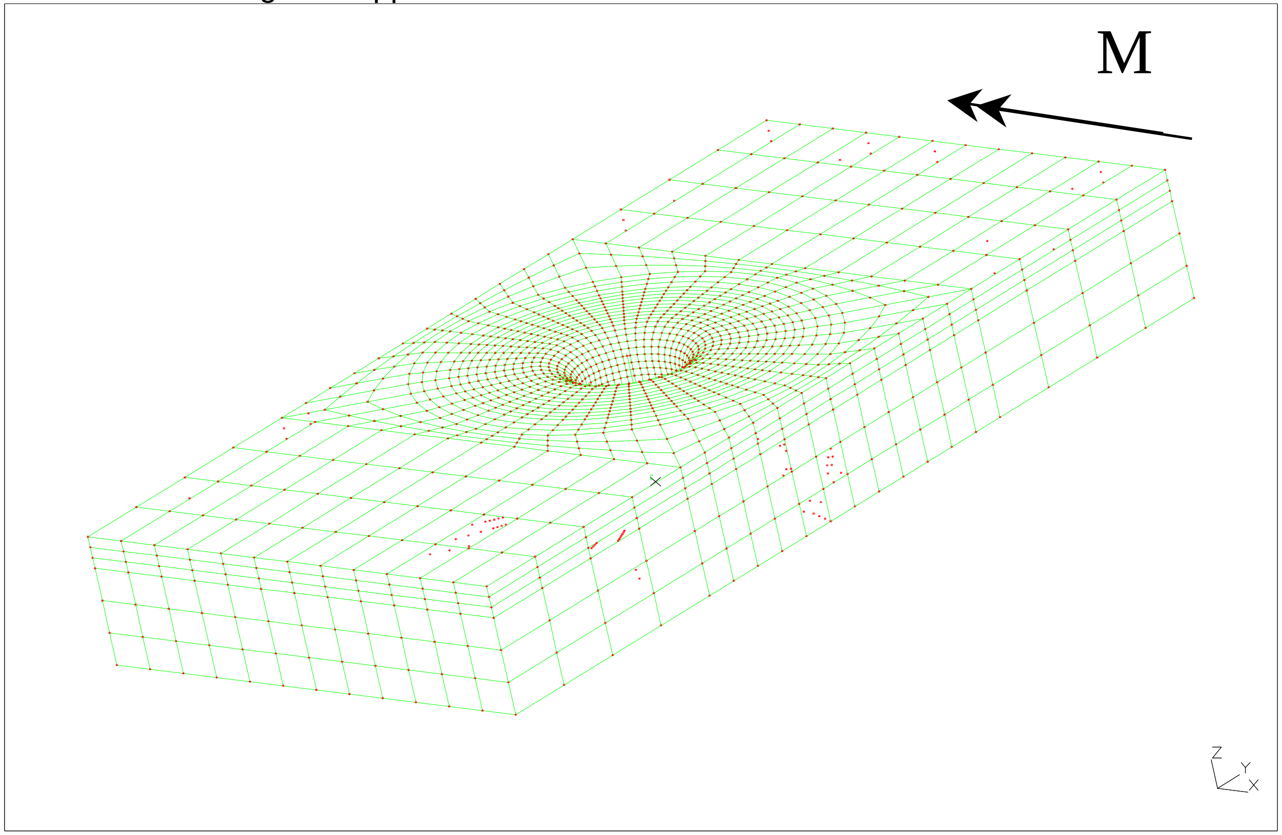
MLG WHEEL TIE-BOLT HOLE CORROSION

Presenter:

Organization/Date:
Orbiter/11-15-01

Locate Peak Stress on Hole Edge Radius

- Hole edge at inner face of wheel has 0.25 inch radius
- Built very simplified model of single hole including edge radius
- Bending load applied



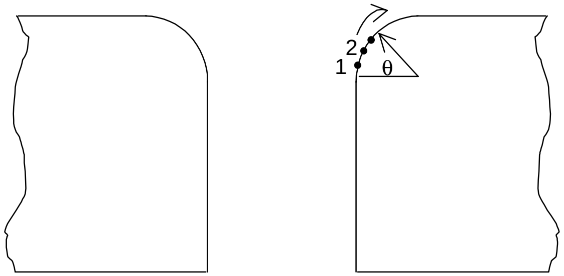
MLG WHEEL TIE-BOLT HOLE CORROSION

Presenter:

Organization/Date:
Orbiter/11-15-01

Principal Stress Peaks at ~30° Up on Hole Edge Radius

Point	θ	Normalized Stress
1	6.3	86
2	18	95
3	30	100
4	42	99
5	54	95
6	66	88
7	78	81
8	90	75



Cross Section Through Hole